



Programa de las
Naciones Unidas
para el Medio Ambiente



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COMITÉ EJECUTIVO DEL FONDO MULTILATERAL
PARA LA APLICACIÓN DEL
PROTOCOLO DE MONTREAL
Trigésima séptima Reunión
Montreal, 17 al 19 de julio de 2002

PROPUESTAS DE PROYECTOS: INDIA

Este documento consta de los comentarios y recomendaciones de la Secretaría del Fondo sobre las siguientes propuestas de proyectos:

Espuma

- Plan sectorial para la eliminación gradual de CFC en el sector de espumas PNUD

Agente de procesos

- Plan sectorial para la eliminación gradual del consumo de tetracloruro de carbono en el subsector de caucho clorado Banco Mundial

DESCRIPCIÓN DEL PROYECTO

Antecedentes del sector

- Último consumo total disponible de SAO (2000)	18.760,46 toneladas PAO
- Consumo básico de sustancias del Anexo A Grupo I (CFC)	6.681,00 toneladas PAO
- Consumo de sustancias del Anexo A Grupo I para el año 2000	5.614,34 toneladas PAO
- Consumo básico de CFC en el sector de espumas	2.391,00 toneladas PAO
- Consumo de CFC en el sector de espumas en 2000	2.898,00 toneladas PAO
- Fondos aprobados para proyectos de inversión en el sector de espumas al final de marzo de 2002	\$EUA 31.858.131,00
- Cantidad de CFC aprobada para proyectos de inversión en el sector de espumas al final de junio de 2002	4.400,90 toneladas PAO
- Cantidad de CFC eliminada de los proyectos de inversión aprobados en el sector de espumas al final de junio de 2002	3.665,40 toneladas PAO
- Cantidad de CFC en proyectos de inversión en el sector de espumas aún no concluidos a finales de junio de 2002	736,30 toneladas PAO
- Cantidad de CFC que se eliminará en proyectos presentados en 37ª Reunión	611,00 toneladas PAO

1. A junio del año 2002, se han aprobado 155 proyectos (excluidos 4 proyectos que se cancelaron) por un valor de \$EUA 31.858.131 para India, destinados a eliminar gradualmente 4.401 toneladas PAO de CFC. Estos proyectos son, principalmente, para empresas que producen espuma rígida, espuma de revestimiento integral y espuma moldeada de poliuretano flexible. Sólo se han aprobado cinco proyectos para eliminar CFC en los otros subsectores: uno en el subsector de espuma fenólica y cuatro en el subsector de espuma extruida de polietileno y poliestireno. También se han aprobado, para apoyar el programa de eliminación gradual de India, cinco actividades de producción de polioliol y de empresas de sistemas por un valor total de \$EUA 1,52 millones. Dos de las empresas de sistemas tienen proyectos que se aprobaron como componentes de proyectos generales para pequeñas y medianas empresas (PME).

2. El análisis del PNUD del consumo sectorial de CFC muestra un consumo total de 639 toneladas PAO de CFC-11 restantes en el sector, de las cuales 612 toneladas PAO, consumidas por 99 empresas, se consideran admisibles para financiación. Las 27 toneladas PAO, consumidas por 27 pequeñas y medianas empresas, no se consideran admisibles para financiación.

Plan sectorial para la eliminación gradual de CFC en el sector de espumas de India

3. El PNUD ha presentado, en nombre del Gobierno de India, un plan sectorial para la eliminación gradual de los CFC financiados restantes en el sector de espumas. Los objetivos del plan son los siguientes:

- a) Lograr una eliminación completa de CFC en el sector de espumas en India en cuatro años.

- b) Permitir a India cumplir con sus obligaciones para lograr reducciones graduales de SAO, de conformidad con el calendario de control del Protocolo de Montreal.
- c) Garantizar la eliminación gradual oportuna, sostenible y rentable de CFC en el sector de espumas, mediante el desarrollo y ejecución de una combinación de las componentes de inversión, apoyo técnico y administrativo.

4. Se solicita una cantidad total de \$EUA 8.473.050 para eliminar 611,8 toneladas PAO de CFC-11 con PAO residuales de 24,01, como resultado del uso de HCFC-141b, lo cual genera una relación costo-eficacia acumulativa de \$EUA 14,42/kg. Esta cantidad comprende:

	\$EUA (incluidos imprevistos del 10%)
Componente del proyecto de eliminación de CFC	6.592.050
Componente de las empresas de sistemas	891.000
Apoyo técnico	440.000
Componente administrativo	550.000
Total	8.473.050

Identificación de empresas admisibles

5. Usando los recursos de los fondos aprobados en la 13ª Reunión de julio de 1994 para el PNUD destinados a preparar una estrategia y un plan de acción para la eliminación gradual de SAO en el sector de espuma de India, el PNUD, en colaboración con el Ministerio de Medio Ambiente y Bosques, hizo varios anuncios públicos y periodísticos para identificar a los usuarios de CFC que aún quedan en el sector. Se llevaron a cabo estudios y talleres en el sector que desembocaron en proyectos, algunos de los cuales ya han sido presentados para su financiación. Los informes de situación sobre el estudio que el PNUD presentó están disponibles a solicitud.

6. Este plan sectorial es el resultado de la interacción continua entre proveedores inmediatos, departamentos gubernamentales, fabricantes de espumas y los expertos locales e internacionales del PNUD. Se organizaron dos talleres de identificación y asistencia técnica como una manera de elevar al máximo la identificación de empresas usuarias de CFC. Se informa que más del 95% de las empresas han sido visitadas por los consultores locales e internacionales del PNUD. Las cifras que se obtuvieron a través del estudio se correlacionaron con los registros de ventas nacionales de SAO de distribuidores y comerciantes, y de proveedores inmediatos de productos químicos, en la medida de lo disponible. El PNUD espera que el margen de error del estudio sea menor que 5%. Un total de 132 empresas consumen 638,8 toneladas PAO de CFC-11, de las cuales se identificaron como admisibles para financiación 99 empresas productoras de espuma que consumen 611 toneladas PAO y 6 empresas de sistemas. En la Tabla 1 que sigue, se presenta el resumen de las empresas admisibles por subsector. Se adjunta una lista de todas las empresas admisibles.

Tabla 1: Consumo admisible restante de CFC en el sector de espumas en India

Subsector	Número de empresas admisibles restantes	Consumo de CFC en 2001 (TM)
Espuma rígida (aislamiento general)	5	56,7
Espuma rígida (aislamiento térmico)	12	116,5
Espuma rígida (espreada/aislamiento en sitio)	14	114,2
Espuma rígida (PME)*	40*	94,1
Espuma moldeada flexible y espuma de revestimiento integral	28	230,3
Total	99	611,8

* Empresas con menos de 5 toneladas/año de consumo de CFC

Consumo básico de las empresas

7. Las cinco empresas que producen cajas, tubería, planchas y tableros aislados y las 12 empresas productoras de elementos térmicos, todas usan surtidores de baja presión. Todos los productores de espuma esperada, a excepción de uno de ellos, usan máquinas de esperado de espuma Polycraft o Gusmer de alta presión. Sin embargo, todos los productores de espuma rígida de las 40 pequeñas y medianas empresas usan operaciones de mezclado manual. Los 28 productores de espuma moldeada usan surtidores de baja presión, a excepción de dos empresas, las que emplean surtidores de alta presión.

Planteamiento de eliminación gradual

8. El planteamiento de eliminación gradual se basa en la premisa de que:

- Cincuenta y cuatro por ciento de las empresas de espuma en India, para las cuales han sido aprobados proyectos de inversión, han formado parte de seis proyectos de grupo, comprendidos proyectos de grupo de pequeñas y grandes empresas, lo cual indica la viabilidad del planteamiento.
- Todas las empresas cubiertas en estos proyectos son, esencialmente pequeñas o medianas, con niveles individuales de consumo básico inferiores a 20 toneladas/año; la mayoría de ellas con menos de 5 toneladas/año.

9. Al concluir que el planteamiento de grupo ha demostrado ser eficaz en términos de la cobertura de empresas, la relación costo-eficacia y la eliminación gradual de CFC, se adopta este planteamiento de grupo, basado en un cálculo proyecto por proyecto, como la modalidad para eliminar gradualmente el consumo financiable restante en el sector de espumas.

Elección de tecnología

10. Se eligió la tecnología de HCFC-141b como la más apropiada para todos los proyectos de espuma rígida y espuma de revestimiento integral dentro del plan, si bien la tecnología con espumación por completo acuosa se usará en los proyectos de espuma moldeada flexible. Esto

implica la sustitución de los surtidores de espuma de baja presión, así como de las operaciones de mezclado manual por surtidores de alta presión para los productores de espuma rígida, y la retroadaptación de los surtidores existentes para los productores de espuma esperada y espuma moldeada flexible.

Cálculo de los costos de proyecto

11. Con base en el planteamiento y la tecnología que se eligieron, se calcularon los costos adicionales de capital para cada empresa individual usando componentes estándares de costo, a saber:

Nuevos surtidores de alta presión	\$EUA 20.000 - \$EUA 80.000
Costos de retroadaptación	\$EUA 7.500 - \$EUA 15.00
Pruebas	\$EUA 2.500 - \$EUA 10.000
Capacitación	\$EUA 2.500 - \$EUA 10.000
Asistencia técnica	\$EUA 5.000 - \$EUA 10.000

12. También, se calcularon los costos adicionales de explotación para cada grupo de proyectos con base en los precios de los sistemas químicos empleados en proyectos aprobados para India, y usando el costo adicional de explotación unitario histórico promedio para cada subsector. Estos cálculos dieron las siguientes cantidades.

Tabla 2: Costos calculados para los proyectos de eliminación gradual, con base en los supuestos del plan de eliminación gradual

Subsector	Número de empresas	Consumo básico de CFC (toneladas)	Impacto del proyecto (toneladas)	CAC (\$EUA)	CAE (\$EUA)	CAC + 10% para imprevistos (\$EUA)	Costo total del proyecto (\$EUA)	Relación costo-eficacia del proyecto (\$EUA/kg)	Umbral de costo-eficacia
Espuma rígida (aislamiento general)	5	56,70	53,30	525.000	91.174	577.500	586.674	11.00	7.83
Espuma rígida (PME)	40	94,10	87,33	1.200.000	157.712	1.320.000	1.477.712	16.92	7.83
Espuma rígida (espreada/aislamiento en sitio)	14	114,20	107,35	385.000	331.294	423.500	754.794	7.03	7.83
Espuma rígida (aislamiento térmico)	12	116,50	109,51	840.000	203.060	924.000	1.127.060	10.29	7.83
Espuma moldeada flexible y espuma de revestimiento integral	28	230,30	230,30	1.120.000	1.282.310	1.232.000	2.515.310	10.91	16.83
Total	99	611,80	587,79	4.070.000	2.065.550	4.477.000	6.461.550		

Otras componentes de la donación solicitada

13. Además del costo de los proyectos de eliminación gradual de CFC, se solicitan fondos de \$EUA 135.000 por empresa para 6 operaciones de empresas de sistemas y el costo de apoyo técnico y administrativo por un total de \$EUA 990.000, comprendido 10% para imprevistos. A continuación se presentan los detalles de los costos que se agregaron:

	\$EUA incluido 10% para imprevistos
Financiación para 6 empresas de sistemas @ \$EUA 135 000 cada una	891.000
Costos de apoyo técnico:	
Establecimiento de normas de producto y calidad para varios productos y aplicaciones de espuma	110.000
Interacción entre usuarios e industria para asistencia tecnológica para aplicaciones mediante talleres técnicos y reuniones	220.000
Programa de capacitación, certificación y permisos para técnicos en espuma	110.000
Gastos administrativos:	
Establecimiento y operación de una unidad administrativa	110.000
Actividades de sensibilización y diseminación de información	110.000
Verificación y certificación	110.000
Elaboración de informes	55.000
Mecanismo de supervisión	165.000
Total	1.881.000

Resumen

14. La siguiente tabla proporciona un resumen del costo del plan, incluidas las cantidades solicitadas para las empresas de sistemas y para los costos de apoyo técnico y administrativo con base en los cálculos anteriores de la Secretaría.

	\$EUA
Costo de los proyectos de eliminación gradual de CFC	6.461.550
Cantidad solicitada para las empresas de sistemas	891.000
Cantidad solicitada para apoyo técnico	440.000
Cantidad solicitada para apoyo administrativo	550.000
Total	8.342.550
Impacto acumulativo del proyecto	587,79
Relación costo-eficacia acumulativa	14,19

Ejecución

15. Ha sido propuesto el siguiente calendario de desempeño y desembolsos para la ejecución del plan.

Tabla 3: Calendario de desempeño y desembolsos

La financiación total de donación que solicita es de \$EUA 8.473.050.

Año	Objetivo de eliminación gradual de SAO (TM)			Consumo restante de SAO (TM)	Desembolso (\$EUA)
	De los proyectos aprobados en curso	Del plan sectorial de eliminación	Total		
2002	221	0	221	1 434	2.000.000
2003	497	0	497	937	2.500.000
2004	298	210	508	429	2.100.000
2005	0	301	301	128	1.500.000
2006	0	128	128	0	373.050
TOTAL	1.016	639	1.655	1.655	8.473.050

16. El plan prefigura los siguientes acontecimientos:

- El primer desembolso de \$EUA 900.000 que cubre las componentes de apoyo administrativo y técnico vence contra la aprobación del plan (supuesta para julio 2002).
- El informe anual sobre el desempeño y la marcha de las actividades para cada año deberá presentarse en el primer trimestre del siguiente año.
- El desembolso para cada año debe hacerse por adelantado, con vencimiento en el primer trimestre, contra el recibo y aceptación del informe anual sobre el desempeño y la marcha de las actividades correspondiente al año precedente y del plan de ejecución del año en curso.

Justificación del uso de HCFC-141b

17. El PNUD estableció que, antes de la preparación de la propuesta, sus expertos evaluarán a las empresas beneficiarias potenciales participantes del subsector de espumas rígidas de poliuretano y sostuvieron discusiones detalladas con el personal técnico y administrativo de las empresas, en relación con la elección de tecnología para sustituir la existente basada en CFC, en el marco del proyecto. Se instruyó con detalle a las empresas sobre lo siguiente:

1. Las tecnologías provisionales (PAO bajo) y permanentes (PAO cero) disponibles.
2. El impacto técnico-económico de cada tecnología sobre los productos fabricados, y los procesos y prácticas que dichas tecnologías emplean.

3. La posible implicación de cada tecnología, en términos de su impacto conocido sobre el medio ambiente, la salud y la seguridad, como el potencial de agotamiento de la capa de ozono, el potencial de calentamiento global, la salud ocupacional y los riesgos de incendio y explosiones.
4. Se les hizo hincapié de que las tecnologías de HCFC son provisionales por su naturaleza, debido a sus PAO residuales y, por lo tanto, pueden seguir afectando el ambiente de manera adversa, aunque a menor escala que los CFC.
5. Se explicó, además, que el uso de HCFC puede quedar restringido bajo los convenios internacionales actuales y futuros y que, también, puede necesitar eliminarse gradualmente en un futuro y, cualquier inversión que se requiera para su eliminación gradual y conversión a tecnologías más seguras tendrá que ser costeadas por ellas.

18. El PNUD también indicó que las empresas seleccionaron una tecnología basada en HCFC-141b después de considerar las dificultades comerciales, de seguridad y operacionales y los costos de las tecnologías basadas en hidrocarburos y en agua. El HCFC-141b les asegura una eliminación más rápida al tiempo que se mantienen la competitividad y las propiedades de sus productos a niveles aceptables. No se encontró viable mencionar la Decisión 36/56 (c) en este plan sectorial.

19. El Gobierno de India ha avalado el uso de HCFC-141b por las empresas.

COMENTARIOS Y RECOMENDACIONES DE LA SECRETARÍA

COMENTARIOS

20. En vista del hecho de que India eligió determinar el costo admisible del plan con base en un planteamiento proyecto por proyecto —en lugar de sobre la base de una estrategia discernible, en la que, por ejemplo, una combinación de instrumentos reglamentarios y de otra índole, así como de actividades de inversión, condujera a la racionalización del costo—, la Secretaría informó al PNUD que el plan se revisaría proyecto por proyecto, en forma consistente con los reglamentos del Fondo Multilateral. Por lo tanto, el plan se revisó contra los antecedentes de los proyectos para espuma aprobados para India, así como contra los informes de terminación que se recibieron de los organismos de ejecución sobre los proyectos de espuma que se concluyeron en India.

21. El análisis de la Secretaría de los fondos solicitados, en relación con los proyectos de espuma aprobados para India, indicó que los valores de la relación costo-eficacia de los subsectores en el plan fueron mucho mayores a los umbrales de costo-eficacia del subsector o a la relación costo-eficacia promedio ponderada de proyectos similares aprobados para India en esos subsectores. La tabla que se presenta a continuación ofrece una comparación entre la relación costo-eficacia promedio ponderada y la relación costo-eficacia de los fondos que se solicitan en el plan.

Subsector	Relación costo-eficacia promedio ponderada de proyectos aprobados para India \$EUA/kg	Relación costo-eficacia en el plan sectorial de espumas de India \$EUA/kg
Espuma rígida (PME excluidas)	6,22	10,09
Espuma rígida (espreado/en sitio, proyectos generales)	4,76	7,03
Espuma rígida (PME)	6,01	16,92
Espuma de revestimiento integral	9,16	10,91

22. Con base en el análisis de informes de terminación de proyecto del sector de espumas que están disponibles, los precios de los surtidores de espumas, según se indica en el plan sectorial para proyectos de espuma rígida, fueron avalados y utilizados en el cálculo que hizo la Secretaría de los costos adicionales admisibles. Sobre la misma base, se establecieron los costos de pruebas en \$EUA 3.000-\$EUA 8.000, si bien los de asistencia técnica fueron \$EUA 2.000-\$EUA 4.000. Los informes de terminación de proyecto mostraron que, en general, no hubo costos de capacitación. Los cálculos de la Secretaría sustentaron todos los factores y los supuestos que el PNUD tomó como base para calcular los costos adicionales de explotación.

23. El cálculo de la Secretaría del costo adicional admisible de los proyectos de eliminación gradual de CFC para 99 empresas del plan dio como resultado, con base en las consideraciones anteriores, la cantidad de \$EUA 4.753.577, con una relación costo-eficacia total de EUA 8,09/kg. El desglose es el siguiente:

Componente del proyecto	Número de empresas	Consumo de CFC Toneladas PAO	Impacto Toneladas PAO	Donación del proyecto \$EUA	Relación costo-eficacia acumulativa \$EUA/kg
Espuma rígida:					
Aislamiento general	5	56,70	53,3	417.323	7.83
Aislamiento térmico	12	116,50	109,51	853.106	7.79
Esprendo/en sitio	14	114,20	107,35	600.799	5.60
PME	40	92,90	87,33	683.739	7.83
Subtotal, espuma rígida	71	380,30	357,49	2.554.967	7.15
Espuma revestimiento integral/moldeada flexible	28	230,30	230,30	2.198.610	9.55
TOTAL	99	610,60	587,99	4.753.577	8.09

Otras componentes de costos

Empresas de sistemas

24. Se han aprobado cinco proyectos para empresas de sistemas en apoyo a la eliminación gradual de CFC de India. Se aprobaron dos de los proyectos específicamente como componentes

de proyectos para pequeñas y medianas empresas (PME) para proporcionar sistemas y apoyo técnico a las empresas de sus clientes inmediatos que fueron identificados, con la finalidad de acelerar su eliminación gradual de CFC. Las actividades de las empresas de sistemas, por sí mismos, no generan un consumo o eliminación de SAO. Tampoco tienen la finalidad de sustituir las actividades de producción que son admisibles para financiación en el marco del Protocolo. Por lo tanto, los proyectos de empresas de sistemas, por sí mismos, no serían admisibles para financiación a excepción de que dichos proyectos se usaran como un instrumento de ejecución del proyecto y como medio para elevar la relación costo-eficacia del proyecto de los productores directos de espuma, así como su tasa de eliminación gradual de CFC. Este ha sido el caso en proyectos de empresas de sistemas aprobados en países como Brasil, Colombia, India y México. En el documento, no hay evidencia de que ese sea el caso con los seis proyectos de empresas de sistemas propuestos en el plan para su financiación a un costo total de \$EUA 891 000.

Costos de apoyo técnico y gastos administrativos

25. La Secretaría observó que algunas de las partidas de costos, como el establecimiento de normas de producto y de calidad, pueden no ser admisibles, o que la modalidad de ejecución proyecto por proyecto puede introducir cierto grado de duplicación en la financiación de algunos de estos costos auxiliares. Sin embargo, se propuso que podría considerarse una cantidad de \$EUA 150.000 para ayudar a la Unidad Nacional del Ozono en la supervisión del programa.

Conclusión

26. Sobre la base de lo que antecede, se recomendó al PNUD, para su consideración con el Gobierno de India, la cantidad de \$EUA 4.903.577, comprendidos \$EUA 150.000 para la Unidad Nacional del Ozono para las actividades de supervisión, como el costo adicional admisible del plan sectorial. Al momento de redactar este documento, la Secretaría no había recibido una respuesta del PNUD.

RECOMENDACIONES

27. Pendiente.

INDIA – FOAM SECTOR: LIST OF REMAINING ELIGIBLE ENTERPRISES**Table A.1: Rigid foam (general insulation) sub-sector**

No	Enterprise name	Location	Year established	Products	CFC Consumption (MT)	Baseline equipment
1	Aakriti Ice Box Co.	Delhi	1989	Insulated boxes	12.1	1 LPD – Local
2	HR Innovations	Mumbai	1991	Insulated doors	9.7	1 LPD – Polycraft
3	Kakar Trading Co.	Delhi	1987	Slabs, pipe/sect	11.0	1 LPD – Local
4	Patton Tanks	Calcutta	1982	Insulated tanks	7.8	1 LPD – Klowpur
5	Suchi Foams	Ahmedabad	1994	Panels	16.1	1 LPD – Klowpur
TOTAL					56.7	5 LPDs

Table A.2: Rigid foam (thermoware insulation) sub-sector

No	Enterprise name	Location	Year established	Products	CFC Consumption (MT)	Baseline equipment
1	Aakar Industries	Noida	1991	Thermoware	11.3	1 LPD – Local
2	Anmol Plast	Delhi	1991	Thermoware	10.6	1 LPD – Local
3	Atul Marketing	Delhi	1992	Thermoware	6.5	1 LPD - Local
4	Balaji Plastics	Delhi	1987	Thermoware	8.0	1 LPD – Local
5	CL Plastics	Delhi	1988	Thermoware	11.0	1 LPD – Local
6	Indus Plast	Sahranpur	1990	Thermoware	9.8	1 LPD – Local
7	Jupiter Engineering	Vapi	1991	Thermoware	9.5	1 LPD - Cannon
8	Mukesh Plastic Engineering	Delhi	1984	Thermoware	8.5	1 LPD – Local
9	Neelam Plastic Industries	Mumbai	1973	Thermoware	9.6	1 LPD – Local
10	Payal Products	Delhi	1987	Thermoware	9.2	1 LPD – Local
11	Pradeep Polymers	Delhi	1993	Thermoware	10.7	1 LPD – Local
12	Thermoplast Industries	Mumbai	1995	Thermoware	11.8	1 LPD - Local
TOTAL					116.5	12 LPDs

Table A.3: Rigid foam (spray/insitu insulation) sub-sector

No	Enterprise name	Location	Year established	Products	CFC Consumption (MT)	Baseline equipment
1	Alpha Insulation	Ahmedabad	1991	Spray/Insitu	6.5	1 HPD – Polycraf
2	Amijit Enterprises	Mumbai	1994	Spray/Insitu	5.8	1 HPD – Polycraft
3	Bright Insulations	Delhi	1979	Spray/Insitu	7.6	1 HPD – Polycraft
4	Enecon Engineers	Mumbai	1987	Spray/Insitu	7.5	1 HPD – Polycraft
5	Insulations India	Vapi	1988	Spray/Insitu	9.5	1 HPD – Gusmer
6	Insultech Enterprises	Yamunangr	1989	Spray/Insitu	6.5	1 HPD – Polycraft
7	Jaya Enterprises	Mumbai	1995	Spray/Insitu	8.4	1 HPD – Gusmer
8	Kwality Insulations	Delhi	1990	Spray/Insitu	8.5	1 HPD – Polycraft
9	Narmada Insulations	Delhi	1993	Spray/Insitu	10.5	1 HPD – Polycraft
10	Om Insulations	Mumbai	1995	Spray/Insitu	8.0	1 HPD – Gusmer
11	Pravin Enterprises	Vadodara	1991	Spray/Insitu	8.5	1 HPD – Polycraft
12	Professional Insulations	Gurgaon	1990	Spray/Insitu	10.8	3 HPD – Gusmer
13	SD Polyurethane Enterp	Ghaziabad	1987	Spray/Insitu	6.6	1 HPD - Polycraft
14	Witco	Vadodara	1993	Spray/Insitu	9.5	1 LPD – Klowpur
TOTAL					114.2	15 HPDs, 1 LPD

Table A.4: Rigid foam (SMEs) sub-sector

No	Enterprise name	Location	Year established	Products	CFC Consumption (MT)	Baseline equipment
1	Advance FRP	Mumbai	1983	RPUF General	2.5	Hand mixing
2	AG Insulators	Noida	1994	RPUF General	2.1	Hand mixing
3	Arci Engineers	Mumbai	1985	RPUF General	2.4	Hand mixing
4	Babylon Plast	Mumbai	1995	Thermoware	2.4	Hand mixing
5	Beegee Enterprises	Dadanagar	1993	Thermoware	1.9	Hand mixing
6	Bhagwati Plastics	Delhi	1993	Thermoware	2.3	Hand mixing
7	Bharat Traders	Mumbai	1992	RPUF General	2.5	Hand mixing
8	Bhoopty Associates	Chennai	1986	RPUF General	2.5	Hand mixing
9	Chemisol Industries	Vapi	1991	RPUF General	2.0	Hand mixing
10	Citizen Industries	Ahmedabad	1991	Thermoware	2.2	Hand mixing
11	Craftway Engineers	Mumbai	1990	Thermoware	2.4	Hand mixing
12	Eaphael Industries	Delhi	1981	Thermoware	2.6	Hand mixing
13	Emcee	Ludhiana	1981	RPUF General	2.0	Hand mixing
14	Ethos Systems	Ahmedabad	1995	RPUF General	2.2	Hand mixing
15	Gautam Industries	Delhi	1991	Thermoware	2.0	Hand mixing
16	Gem Ply Systems	Mumbai	1993	RPUF General	2.9	Hand mixing
17	HPN Industries	Bangalore	1991	RPUF General	2.0	Hand mixing
18	Jain Plast	Mumbai	1994	Thermoware	2.4	Hand mixing
19	Jay Vee Cee Corporation	Mumbai	1995	RPUF General	2.5	Hand mixing
20	Jonex Rubber Industries	Jalandhar	1989	RPUF General	2.0	Hand mixing
21	Malabar Thermoware	Bangalore	1994	Thermoware	3.0	Hand mixing
22	Mayur Extrusions	Sarigam	1992	Thermoware	3.0	Hand mixing
23	Modern Flask	Mumbai	1990	Thermoware	2.4	Hand mixing
24	Nissan Doors	Mumbai	1985	RPUF General	2.2	Hand mixing
25	Palmline Plastics	Mumbai	1994	Thermoware	2.5	Hand mixing
26	Pawan Procast	Mumbai	1995	RPUF General	1.8	Hand mixing
27	Polyfoam Industries	Mumbai	1995	RPUF General	1.8	Hand mixing
28	Ram Enterprises	Bangalore	1994	RPUF General	2.2	Hand mixing
29	Reliance Engineers	Mumbai	1987	RPUF General	2.4	Hand mixing
30	Sanjay Metals	Mumbai	1994	Thermoware	2.2	Hand mixing
31	Sharda Construction	Mumbai	1994	RPUF General	2.5	Hand mixing
32	Sharp Industries	Mumbai	1989	RPUF General	2.5	Hand mixing
33	Sheth Fabricators	Mumbai	1992	RPUF General	2.8	Hand mixing
34	Shreya Insulations	Bilimora	1990	RPUF General	2.7	Hand mixing
35	SM Polymers	Faridabad	1994	RPUF General	2.0	Hand mixing
36	Spark Allied Industries	Bangalore	1992	RPUF General	2.2	Hand mixing
37	SS Enterprises	Mumbai	1995	Thermoware	1.7	Hand mixing
38	Sri Venkateshwara Ind	Bangalore	1995	RPUF General	2.0	Hand mixing
39	Toshbro Industries	Daman	1994	RPUF General	2.7	Hand mixing
40	Tristar	Mumbai	1994	RPUF General	2.5	Hand mixing
TOTAL					94.1	No Foam Dispensers

Table A.5: Flexible Molded/Integral Skin foam sub-sector

No	Enterprise name		Year established	Products	CFC Consumption (MT)	Baseline equipment
1	ABH Industries	Valsad	1994	FMF	4.5	1 LPD – Local
2	APL Corporation	Chennai	1994	FMF/ISF	7.5	2 LPD – Cannon/SAIP
3	AS Polymers	Ambala	1994	FMF	6.0	1 LPD – Local
4	Bhutani Industries	Gurgaon	1994	FMF	10.5	1 LPD – Cannon
5	Crypton Industries	Calcutta	1991	FMF/ISF	7.5	1 HPD – Hennecke
6	Durotex Polymers	Coimbatore	1993	FMF	4.8	1 LPD – Local
7	Foam India	Tiruchirapali	1994	FMF	9.5	1 LPD – Local
8	Foam Products	Bangalore	1984	FMF	5.4	1 LPD – Local
9	Gopsy Rubber Industries	Mumbai	1990	FMF	4.8	1 LPD – Local
10	Indrayani Udyog	Nagpur	1994	FMF	12.5	1 LPD – Local
11	Jindal Petrofoams	Ambala	1994	FMF	4.5	1 LPD – Local
12	Joginder Singh	Ludhiana	1965	FMF	6.0	1 LPD – Local
13	Koyas Polymers	Coimbatore	1971	FMF	11.0	1 LPD – Elastogran
14	Kvik Thermofoam	Mumbai	1990	FMF	8.3	1 LPD – Local
15	Lux Autofoam	Coimbatore	1994	FMF	6.6	1 LPD – Local
16	National Polymers	Mumbai	1992	FMF	4.0	1 LPD – Local
17	Omega Lining	Coimbatore	1992	FMF	13.5	1 LPD – Local
18	Poly Crafts	Delhi	1987	FMF	10.4	1 LPD – Hennecke
19	Premier Industries	Medak	1995	FMF	14.1	1 LPD/Local, 1 HPD Henn
20	Pyarelal Foams	Meerut	1994	FMF	12.0	1 LPD – Local
21	Sigma Industries	Delhi	1993	FMF/ISF	13.6	1 LPD – KWI
22	Siddhi Vinayak Polymers	Jalandhar	1994	FMF	12.4	2 LPD – OMS/Indipuf
23	Sunpreet Engineers	Chennai	1995	FMF	4.8	1 LPD – Local
24	Surbhi Polymers	Delhi	1993	FMF	9.7	1 LPD – Local
25	Transval Manufacturing	Chennai	1994	FMF	4.8	1 LPD – Local
26	Urethane Specialties	Hyderabad	1993	FMF	9.0	1 LPD – OMS
27	Vam Polyplast	Hyderabad	1989	FMF	8.0	1 LPD – Graco
28	Vicktra Polyfoams	Chennai	1995	FMF	4.6	1 LPD – Local
TOTAL					230.3	28 LPDs, 2 HPDs

- NOTES:**
- All enterprises mentioned as established in 1995 in Tables 2.1 to 2.5, commenced operations prior to July 1995.
 - It has been ensured that there has been no double counting of enterprises.

Table A.6: Summary

Sub-sector	Number of Enterprises	CFC Consumption (MT)
Rigid foam (general insulation)	5	56.7
Rigid foam (thermofoam)	12	116.5
Rigid foam (spray/insitu)	14	114.2
Rigid foam (SMEs)	40	94.1
Flexible molded & integral skin foam	28	230.3
TOTAL	99	611.8

GOVERNMENT NOTE OF TRANSMITTAL OF INVESTMENT PROJECTS TO THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL

PROJECT OF THE GOVERNMENT OF INDIA

The Government of India requests UNDP to submit the Sectoral Phase-out Plan for elimination of CFCs in the Foam Sector in India to the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol for consideration at its 37th Meeting. (project copy is enclosed)

Section I: ODS Consumption Data

1. The ODS consumption figure of the project has been validated by the National Ozone Unit (NOU).
2. The consumption data have been retained in the records of the NOU for reference and/or future verification.
3. The Government has been advised by the NOU that the agreement to the project indicates a commitment to ensure that the validated phase-out figure was realized and yielded a sustained reduction from the 2000 consumption of 2898 ODS metric tonnes for the foam sector.

Table 1: Project Submitted to the 37th Meeting of the Executive Committee

No.	Name of Recipient Enterprise	Sector/Sub-Sector	ODS phaseout (ODP-MT)	Grant Requested (US\$)	Implementing Agency
1.	Sectoral Phase-out Plan for elimination of CFCs in the Foam Sector in India with an indicative list of industries. Remaining industries will be added to the list after the last date of registration of enterprises using ODS i.e. 19 th July 2002.	Foam Sector	611	8,473,050	UNDP

Section II: Other Relevant Actions Arising from Decision 33/2

4. It is understood that, in accordance with the relevant guidelines, the funding received for a project would be partly or fully returned to the Multilateral Fund in cases where technology was changed during implementation of the project without informing the Fund Secretariat and without approval by the Executive Committee;
5. The National Ozone Unit undertakes to monitor closely, in cooperation with customs authorities and the environmental protection authorities, the importation and use of CFC and to combine this monitoring with occasional unscheduled visits to importers and recipient manufacturing companies to check invoices and storage areas for unauthorized use of CFC.

6. The National Ozone Unit will cooperate with the relevant implementing agencies to conduct safety inspections where applicable and keep reports on incidences of fires resulting from conversion projects.

Section III: Projects Requiring the Use of HCFCs for Conversion

7. In line with Decision 27/13 of the Executive Committee and in recognition of Article 2F of the Montreal Protocol, the Government
- (a) has reviewed the specific situations involved with the project *(as per the indicative list of enterprises and additional enterprises which will be added after 19th July 2002)* as well as its HCFC commitments under Article 2F; and
 - (b) has nonetheless determined that, at the present time, the projects needed to use HCFCs for an interim period with the understanding that no funding would be available for the future conversion from HCFCs for the company/companies involved.

Name:
Designation:
Telephone:
Fax:
E-mail:

Usha Chandrasekhar
Usha Chandrasekhar
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Date: 24th April, 2002

HOJA DE EVALUACIÓN DEL PROYECTO INDIA

SECTOR: Agente de procesos Uso de SAO en el sector (2000): 4.067 toneladas PAO

Umbral de costo-eficacia en el subsector: No se aplica

Título del proyecto:

- a) Plan sectorial para la eliminación gradual del consumo de tetracloruro de carbono (CTC) en el subsector de caucho clorado

Datos del proyecto	Conversión del proceso
Consumo de la empresa (toneladas PAO)	
Impacto del proyecto (toneladas PAO)	382,00
Duración del proyecto (meses)	36
Monto inicial solicitado (\$EUA)	18.066.845
Costo final del proyecto (\$EUA):	
Costo de capital adicional a)	
Gastos imprevistos b)	
Costos de explotación adicionales c)	
Costo total del proyecto (a+b+c)	22.533.153
Propiedad local (%)	100%
Componente de exportación (%)	30.4%
Monto solicitado (\$EUA)	18.066.845
Costo-eficacia (\$EUA/kg.)	47,30
¿La contraparte confirmó la financiación?	
Organismo nacional de coordinación	Ministerio de Medio Ambiente y Bosques
Organismo de ejecución	Banco Mundial

Recomendaciones de la Secretaría	
Monto recomendado (\$EUA)	
Impacto del proyecto (toneladas PAO)	
Costo-eficacia (\$EUA/kg)	
Gastos de apoyo del organismo de ejecución (\$EUA)	
Costo total para el Fondo Multilateral (\$EUA)	

DESCRIPCIÓN DEL PROYECTO

Plan sectorial para la eliminación gradual del consumo de tetracloruro de carbono en el subsector de caucho clorado

Objetivo

28. En nombre del Gobierno de India, el Banco Mundial ha presentado en la 37ª Reunión un plan subsectorial propuesto para la conclusión de la eliminación gradual de CFC que se emplean como agentes de procesos en la fabricación de caucho clorado en India.

29. El Banco Mundial ha informado que el objetivo del plan subsectorial es eliminar completamente el consumo restante de CTC de 382 toneladas PAO, y evitar 2.878 toneladas PAO de consumo proyectado de CTC, en la industria de caucho clorado de India.

30. El plan propone conversiones de los procesos en dos plantas, Rishiroop Rubber International Limited (RRIL) y Rishiroop Polymers Limited (RPL), y el cierre de dos plantas pequeñas. Se proponen costos adicionales totales para la conversión y el cierre de \$EUA 19.942.183 para una relación costo-eficacia de \$EUA 52.20 por kilogramo. Se consideró la eliminación gradual de 249 toneladas PAO de CTC en la quinta planta de caucho clorado de India, Rishiroop Organics Limited (ROL), mediante un proyecto aprobado en la 34ª Reunión.

31. Se adjunta a este documento una copia de la propuesta completa (Anexo I)

Componentes y ejecución

32. El plan tiene dos componentes, cierre de planta y conversión de planta, según se mencionó anteriormente. La ejecución de las dos componentes será para finales del año 2004 para completar la eliminación gradual. El plan subsectorial no contiene actividades complementarias de asistencia técnica o administrativas. Se indicó que el plan subsectorial será aplicado por los productores de caucho clorado de India.

Costo adicional

33. La propuesta presenta el cálculo de los costos para cuatro opciones: cierre de planta, conversión de planta, reducción de las emisiones y racionalización industrial. La última opción, que combina el cierre de dos plantas y la conversión de dos, a plena capacidad instalada, se calcula que es la opción más rentable.

34. Se solicitan costos adicionales de \$EUA 2.909.947 para el cierre de dos plantas con una capacidad total de 450 toneladas anuales y una producción real de 71 toneladas al año indicadas en la propuesta. Los costos solicitados se basan en pérdidas de ganancias y en compensación laboral. En los cálculos de las pérdidas de ganancias se usa una producción de referencia de 1995-1997, un crecimiento no restringido hasta el año 2010 (12%), una inflación del 3% y un porcentaje de descuento de 7% sobre el flujo de ganancias.

35. Se solicitan costos adicionales de \$EUA 18.260.359 para las conversiones de las dos plantas, con una capacidad total de producción de 5.050 toneladas y una producción real de 507 toneladas anuales. Estos costos son antes de la asignación por concepto de exportaciones, lo cual se aplica a todo el plan subsectorial.

36. El plan comprende propuestas independientes de subproyectos para la conversión de RRIL y RPL. Las propuestas se basan en la sustitución de la mayor parte del equipo e infraestructura de proceso a un costo de capital de \$EUA 15.496.083 para RRIL y de \$EUA 2.612.447 para RPL. Los costos adicionales de explotación de \$EUA 161.829 se asocian completamente a RRIL, puesto que RPL no ha estado en producción desde 1995.

37. El Gobierno de India ha solicitado plena flexibilidad en cuanto a cómo son utilizados y distribuidos los fondos propuestos, siempre y cuando el consumo de CTC se elimine gradualmente según lo proyectado.

COMENTARIOS Y RECOMENDACIONES DE LA SECRETARÍA

COMENTARIOS

38. La financiación de \$EUA 200 000 fue proporcionada para el Banco Mundial y ONUDI en la 33ª Reunión para preparar un plan sectorial para el sector de agentes de procesos en India. El Banco Mundial era quien sería responsable de asistir a India en el desarrollo de todo el plan sectorial, comprendidos todos los subsectores, con la intención de poderlo presentar al Comité Ejecutivo en su 35ª Reunión. Se pidió al Banco Mundial que indicara la situación en la que se encontraba la preparación del plan sectorial en conjunto.

39. Esta propuesta es para la eliminación gradual dentro de un subsector de agentes de procesos, a saber, caucho clorado. No habrá acuerdos de desempeño para aplicarse cada año, a excepción de la eliminación gradual del consumo en las tres empresas que ahora utilizan CTC en la fabricación de caucho clorado, y no se solicitan pagos en partes. Por lo tanto, no es un plan sectorial como actualmente se conoce. Puesto que la propuesta es fundamentalmente un proyecto para la conversión de sólo una planta productora, RRIL (véase a continuación) y para el cierre de dos plantas pequeñas, la noción de flexibilidad puede no aplicarse aquí. El Banco Mundial considera que están incluidas todas las características de un plan sectorial y que, por lo tanto, debe haber la misma flexibilidad que en los otros planes sectoriales.

Mercado de caucho clorado: Capítulos del 1 al 3 del documento de proyecto

40. El propósito principal de estos capítulos parece ser el de establecer que debe ser admisible para financiación toda la capacidad de producción de caucho clorado en India, la cual tiene una tasa de uso histórico máximo de 24% y una tasa actual de utilización de 12%. El caucho clorado que se produce usando CTC usualmente contiene pequeñas cantidades de CTC. En el documento se propone que la falta de aceptabilidad por parte de los usuarios del caucho clorado que contiene CTC se debe al Protocolo de Montreal. Además, se propone que cuando el

proceso de producción esté convertido y el caucho sin CTC esté disponible, el mercado para el producto aumentará para absorber toda la capacidad de producción que teóricamente existe en India.

41. El Protocolo de Montreal controla la producción y el consumo, no el uso final. Por lo tanto, la primera propuesta no es correcta. El mercado de caucho clorado ha disminuido mediante la adopción de tecnologías alternativas que emplean otros productos. Las afirmaciones de que este descenso en el mercado podría revertirse y que la disponibilidad de caucho clorado sin CTC daría efecto a un resurgimiento del mercado parecen especulativas. La Secretaría informó al Banco Mundial que la provisión de recursos del Fondo Multilateral para cubrir estas eventualidades no pareció ser admisible. El Banco Mundial ofreció argumentos adicionales para apoyar su posición de que es probable un crecimiento en el mercado para caucho clorado sin CTC, comprendida la sugerencia de que un productor que no pertenece al Artículo 5 propuso ampliar su capacidad.

Conversión de Rishiroop Polymers Limited (RPL)

42. La situación de esta empresa no ha cambiado desde marzo de 2000, cuando el Banco Mundial presentó, por primera vez, una propuesta para conversión tanto de RPL como de ROL. Más tarde, la Secretaría informó a RPL que no era admisible para financiación porque no había habido consumo durante los últimos tres años. El Banco Mundial revisó el proyecto para su presentación en la 34ª Reunión para retirar la solicitud de financiación de RPL, sobre la base de que la empresa reiniciaría su producción y presentaría un proyecto después. Como se indica en la propuesta actual, todavía no hay consumo y la Secretaría informó al Banco Mundial que la conversión de RPL sigue siendo inadmisibles para financiación. El Banco Mundial sugirió que si la conversión no era admisible, podría considerarse una opción de cierre. Sin embargo, sin consumo, la Secretaría tampoco ve cómo pueden considerarse admisibles los costos de cierre.

Cierre de Pauraj y Tarak

43. Bajo la Decisión X/14 de las Partes, los costos de cierre son admisibles. Se necesita considerar cuidadosamente la base para estos costos. Por ejemplo, el uso de estimados de producción partiendo de un “crecimiento no restringido” desde una base que representa el nivel más alto de producción anual logrado en India no parece válido. Los muy bajos niveles actuales de producción se derivan de una gran variedad de factores, entre los que se cuenta la adopción de las tecnologías alternativas arriba referidas y las condiciones que se aplican a cada empresa productiva individual. Por ejemplo, en Pauraj, la producción está descendiendo con rapidez y ahora es sólo de 33 toneladas anuales, en tanto que en Tarak, la producción promedio en los últimos tres años es de 140 toneladas. Esto indica que la viabilidad de una planta puede ser diferente a la de la otra, en cuyo caso diferiría la compensación por pérdida de ganancias. El Banco Mundial indicó que está dispuesto a discutir estos asuntos con mayor detalle y facilitar visitas al sitio en caso de ser necesarias, para establecer las condiciones sobre las cuales debe basarse el cálculo de compensación por cierre.

Racionalización industrial

44. Las plantas de Pauraj y Tarak deben cerrarse para llevar a cabo una racionalización industrial. La Secretaría señaló que no sería correcto describir esta racionalización como una respuesta a las medidas de control del Protocolo de Montreal. Es, también, una respuesta económica al exceso de capacidad. El Comité Ejecutivo ha indicado, a través de sus decisiones previas en relación con otros países con un exceso importante de capacidad como China, que los costos adicionales para un subsector o grupo de proyectos debe basarse en la conversión de niveles razonables de capacidad industrial, es decir, sobre la base de los costos adicionales admisibles de las empresas que queden después de haberse llevado a cabo la racionalización.

45. Al respecto, como se indica en la Tabla 6 del plan (página 13), la capacidad teórica de producción para la manufactura de caucho clorado es más de ocho veces el nivel real de producción y más de cuatro veces el nivel más alto de producción jamás alcanzado desde que la capacidad de producción de 6.050 toneladas se instaló en 1993-1994. El cierre de Pauraj y Tarak reduciría la capacidad total de 6.050 toneladas anuales a 5.600 toneladas anuales, aún 7,5 veces el nivel actual de producción.

46. La Secretaría informó al Banco Mundial que no era realista sugerir al Comité Ejecutivo que el Fondo Multilateral debía proporcionar compensación para la conversión de este nivel de exceso de capacidad sobre la base de una especulación sobre el posible crecimiento futuro en el mercado de caucho clorado derivado de la disponibilidad de producto sin CTC. Al respecto, el plan debe abordar las disposiciones de la Decisión 32/59(c), la cual establece que de presentarse más tarde un proyecto para conversión de Rishiroop Rubber International Limited, deben tomarse en cuenta, al determinar el costo del proyecto, los costos y beneficios derivados de la racionalización industrial en el subsector.

47. El Banco Mundial se refirió a la información proporcionada sobre el mercado internacional de caucho clorado e indicó que, según su parecer, no era correcto concluir que era especulativo el crecimiento futuro en el mercado de caucho clorado.

Proyectos de conversión

48. Los costos adicionales para el proyecto de RRIL deberán determinarse de conformidad con los reglamentos y políticas del Fondo Multilateral. Esto incluirá considerar la mejora tecnológica y las exportaciones a países que no pertenecen al Artículo 5 de 55,8%. También, sería objeto de consideración la participación en los costos para tener en cuenta el exceso de capacidad en todo el sector.

49. La información contenida ahora en la propuesta para RRIL no proporciona ninguna base para evaluar los costos adicionales. Se invitó al Banco Mundial para que proporcionara información técnica completa sobre la instalación actual (básica) en RRIL, con particular referencia al diseño de la planta, las condiciones actuales de proceso y el equipo auxiliar (teniendo en mente la consistentemente baja tasa de utilización), las partes de la planta destinadas a sustituirse y las que se reutilizarán.

Discusiones subsiguientes

50. Con relación al cálculo de los costos de conversión para RRIL, el Banco Mundial dijo que, puesto que la tecnología alternativa fue la misma que se empleó en Rishiroop Organics Limited (aprobada en la 34ª Reunión), ya se había proporcionado a la Secretaría toda la información relevante. Sobre esta base, la Secretaría informó al Banco Mundial que podría apoyar un planteamiento para el Comité Ejecutivo para la aprobación de financiación sobre la base de la relación costo-eficacia del proyecto ROL, después de un ajuste a los costos de transferencia de tecnología que ya han sido pagados mediante el proyecto de ROL. La relación costo-eficacia ajustada es \$EUA 7,38 por kilogramo. Esta relación costo-eficacia puede aplicarse al nivel de consumo total promedio de CTC para los últimos tres años de todas las plantas restantes de caucho clorado de India, después de justificar la eliminación aprobada para ROL. Esta cifra para el consumo es de 275,2 toneladas PAO. El nivel resultante de los costos adicionales sería de \$EUA 2.030.976. La Secretaría señaló que esta metodología proporcionaría financiación para aquellas empresas que siguen produciendo y cuyo cierre que se propone, a la misma relación costo-eficacia que se aplicaría en el caso de que fueran convertidas, proporcionando, así, máxima flexibilidad a las empresas individuales para que decidan si desean cerrar o hacer la conversión.

51. El Banco Mundial consideró que esta metodología no capturó costos admisibles en relación con el cierre de plantas y que sólo reflejó una fracción de los costos adicionales totales en los que incurriría la industria de India. Además, no reflejaron la capacidad de producción requerida para satisfacer la futura demanda de caucho clorado sin CTC. El Banco Mundial desea explorar más la cuestión con la Secretaría a fin de garantizar que el nivel de financiación bajo el plan sectorial permita a la industria de India equilibrar su capacidad de producción con su demanda futura.

52. Se informará al Subcomité de Examen de Proyectos de cualquier desarrollo ulterior.

RECOMENDACIÓN

53. Pendiente.

Annex I
37th MEETING OF THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR
THE IMPLEMENTATION OF THE MONTREAL PROTOCOL

PROJECT COVER SHEET

COUNTRY:	India	IMPLEMENTING AGENCY:	World Bank
PROJECT TITLE:	Sector Plan for Phasing Out of CTC Consumption in the Chlorinated Rubber Sub-Sector in India		
PROJECT IN CURRENT BUSINESS PLAN:	Yes		
SECTOR/SUB-SECTOR:	Solvents/Process agents		
ODS USE IN SUB-SECTOR:	Baseline (1999-2001) 524 ODP tons Current (2001) 305 ODP tons		
PROJECT IMPACT (ODS TO BE ELIMINATED):	Projected Phase out 347 MT CTC or 382 ODP MT (2001 ODP tons)		
PROJECT DURATION:	36 months		
PROJECT COSTS:	Option 4: Industrial Rationalization		
Investment Activities			
Incremental Capital Cost	US\$22,533,153		
Contingency (10%)			
Incremental Operating Cost			
Sub-total	<u>US\$22,533,153</u>		
Non-investment Activities	US\$0		
Total Project Costs	US\$22,533,153		
LOCAL OWNERSHIP:	100%		
EXPORT COMPONENT:	USD 4,466,308 (30.38% deduction to non-article (5) countries).		
REQUESTED GRANT:	US\$18,066,845		
IA SUPPORT COST:	US\$1,875,338		
TOTAL COST TO MLF:	US\$19,942,183		
COST EFFECTIVENESS:	US\$47.3 /kg ODP. US\$6.89/kg ODP based on Projected Consumption)		
PROJECT MONITORING MILESTONES INCLUDED:	Yes		
NATIONAL COORDINATING AGENCY	MoEF, National Ozone Unit		

PROJECT SUMMARY

The objective of this sub-sector plan is to completely phase out the remaining CTC consumption of about 382 ODP MT (based on 2001 consumption) and 2878 ODP MT of projected CTC consumption, in the chlorinated rubber industry in India. The phaseout plan will focus on actions to ensure sustainable phaseout of the use of CFC in the four remaining chlorinated rubber manufacturers in India. These are Rishiroop Polymers Pvt. Ltd. (RPL), Pauraj Chemicals Pvt. Ltd., Rishiroop Rubber International Ltd. (RRIL), and Tarak Chemicals Ltd.

This sub-sector plan entails conversions at RPL and RRIL, and closure of chlorinated rubber plants at Pauraj and Tarak. The total financial assistance requirement to carry out this sub-sector plan is US\$19,942,183. With the ExCom's approval on the requested provision for flexibility for India to implement this proposed sub-sector plan, this sub-sector plan will contribute to the country's ability to meet the 85% reduction target for CTC in 2005 and 100% reduction target in 2010.

Prepared by: Indian Chemical Manufacturers Association and the World Bank **Date:** March 21, 2002
Reviewed by: W. Kenyon **Date:** April 22, 2002

Sector Plan for Phasing Out of CTC Consumption in the Chlorinated Rubber Sub-Sector in India

Prepared jointly by Indian Chemical Manufacturers Association
and the World Bank

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Chapter 1

Introduction and Objective of the Sub-Sector Plan

Introduction

India became a Party to the Vienna Convention for Protection of the Stratospheric Ozone Layer on June 19, 1991, and the Montreal Protocol on Substances that Deplete the Ozone Layer on September 17, 1992. India was categorized by the Montreal Protocol as a country operating under paragraph 1 of Article 5 as India is a developing country with a per capita consumption of Annex A, Group I chemicals of less than 0.3 kg. India, as well as other countries operating under paragraph 1 of Article 5, is eligible for financial and technical assistance including transfer of technologies from the Multilateral Fund. The Multilateral Fund is a financial mechanism, which was established by the Parties of the Montreal Protocol in 1990. The objective of this Fund is to provide technical and financial assistance to countries operating under paragraph 1 of Article 5 in order to ensure their full compliance with the control measures stipulated in this global environmental treaty.

India began to phase out consumption of ozone depleting substances (ODSs) in 1994 under its National Program for Phaseout of ODSs with the support from the Multilateral Fund. The Executive Committee of the Multilateral Fund has approved a total of 276 ODP phase-out projects for India, with a funding level of some US\$130 million. Of these, 226 are investment projects and 50 are non-investment and technical assistance activities. These 226 investment projects include one investment activity for phasing out the use of CTC in the production of chlorinated rubber at Rishirop Organic Limited (ROL).

The total Bank funding commitments to India under the Montreal Protocol now stands at over \$100 million, of which about \$60 million has been disbursed. Implementation to date has resulted in the phaseout of over 3,000 MT of annual ODS consumption in the manufacturing sector and about 4,000 MT of CFC production.

With funding already provided by the Multilateral Fund, India was able to reduce its consumption of Annex A, Group I chemicals well under the interim phaseout target stipulated in the Montreal Protocol. India is expected to maintain its consumption of these chemicals under the baseline consumption as allowed by the Protocol. With the momentum initiated by the earlier action of the Government of India, India is expected to meet its upcoming 50% consumption reduction in 2005.

For Annex B, Group II chemical or CTC, the first obligation, that requires India to reduce its consumption of CTC by 85% of its baseline consumption level (average consumption during the period from 1998 – 2000), will become effective on January 1, 2005. By January 1, 2010, India is required to completely phase out its CTC consumption, except for feedstock applications.

The baseline of CTC consumption in India is 10,460 MT. It is expected that without further phaseout activities it is likely that India will have difficulty in meeting the 85% CTC consumption reduction in 2005. Basically, India will have to reduce its current CC consumption of 11,043 MT to 1,656 Mt within a period of about two years. The major consumption/emissions of CTC are in the chlorinated sub-sector and agro-chemical sub-sector where endosulfan and dicofol production facilities are in operation.

In the pharmaceutical sub-sector, available information indicates that CTC is used mainly for production of Bromehexine Hydrochloride, Cloxacilin, Chlorophenesin, Diclofenac Sodium, Ibuprofen, Isosorbid Mononitrate, Omeprazol, and Phenyl Glycine. A large part of CTC use in this sub-sector is in the small scale sector. It is estimated that CTC consumption in the pharmaceutical sub-sector is about 15 – 20% of overall CTC consumption in the process agent sector. Table 1 shows usage and emissions of CTC in India as estimated in 1995 for that same year and projected for 2000.

Table 1: Application –wise Usage and Emissions of CTC in India (in MT)*

Product	1995 Process Inventory	1995 Emissions	2000 Projected Process Inventory	2000 Projected Emissions
Chlorinated Rubber (CR)	8,100	800	22,000	1,800
Agricultural Chemicals				
Endosulfan	14,400	590	14,715	604
Dicofol	1,200	110	2,500	250
Pharmaceuticals				
Bromehexine hydrochloride	100	10	500	50
Diclofenac sodium	100	12	160	16
Cloxacilin	100	10	130	13
Chlorophensin	200	20	200	20
Ibuprofen	850	271	1,000	320
Phenyl glycine	2,400	240	2,500	250
Isosorbid mononitrate	70	7	100	10
Omeprazol	140	14	210	21
Total	27,660	2,084	44,015	3,354

*1997 TEAP Report, Volume II, pp. 103, Table 5.4

In 1993, when the India Country Program was formulated, the main source of emission of CTC was identified to be from the production of Ibuprofen. Many of the 14 Ibuprofen producers have phased out their use of CTC and converted their processes to non-ODS solvents. As a result, CTC emissions from Ibuprofen production have dropped significantly between 1993 and 1995. However other uses of CTC for production of

chlorinated rubber, endosulfan and dicofol remained increasing sources of emissions of CTC in India during that period. It was projected by TEAP in 1995 that the CTC emissions from the chlorinated rubber sub-sector would grow from 800 MT in 1995 to 1,800 MT in 2000.

Due to the control measure stipulated in the Montreal Protocol, the industrial norm has become much more stringent against chlorinated rubber produced with and contained with CTC. This has had a direct impact on the growth of the chlorinated rubber industry in India. As a result, the actual consumption of CTC in the chlorinated rubber sub-sector in India, which is shown in Table 2, is lower than the value projected by TEAP.

Table 2: CTC Consumption in the Chlorinated Rubber Sub-Sector

Year	CTC Consumption (MT)
1995	460
1996	847
1997	878
1998	726
1999	602
2000	549

While the CTC consumption in the chlorinated rubber sub-sector in India is lower than the projected value made by the UNEP TEAP, to meet the 85% reduction target in 2005 India is still required to further reduce its CTC consumption in all applications.

To ensure its full compliance with this obligation, the Government of India would like to seek assistance from the Multilateral Fund to phase out the use of CTC in all major applications: CTC used as process agents in the pharmaceutical industry, CTC used for production of chlorinated rubber and agro-chemicals, CTC used as a solvent, and other uses.

Currently, the Government of India has assigned UNIDO to take lead in developing activities to phase out the use of CTC as process agents in the pharmaceutical companies. The World Bank is charged with responsibility to develop a strategy for phasing out the use of CTC in the production of chlorinated rubber and agro chemicals, while UNEP is developing a strategy to phase out the use of CTC as solvent cleaning agents.

As the Multilateral Fund has already approved one investment project with a total funding of \$2,074,300 to phase out the use of CTC as a process agent for the production of chlorinated rubber at ROL, 226 MT of CTC will be permanently phased out when the proposed conversion is completed. Therefore, there are only four remaining chlorinated rubber producers that need financial assistance from the Multilateral Fund.

The proposed chlorinated rubber sub-sector plan is part of the overall CTC phaseout strategy for the process agent sector of the Government of India. The proposed plan for

phasing out of CTC use as a process agent in the agro-chemical industry will be submitted separately to the ExCom at the last meeting of the ExCom in 2002.

Objectives of the India Chlorinated Rubber Sub-Sector Plan

The objective of this sub-sector plan is to completely phase out the remaining CTC consumption of about 347 MT, excluding the consumption level of ROL which will be automatically phased out by the investment project already approved by the Multilateral Fund, in the chlorinated rubber industry in India. The phaseout plan will focus on actions to ensure sustainable phaseout of the use of CTC in the four remaining chlorinated rubber manufacturers in India. These are: (1) Rishiroop Polymers Pvt. Ltd. (RPL); (2) Pauraj Chemicals Pvt. Ltd.; (3) Rishiroop Rubber International Ltd. (RRIL); and, (4) Tarak Chemicals Ltd. All enterprises are 100% locally owned.

The sub-sector plan aims to phase out 347 MT of CTC used as a process agent in the chlorinated rubber production process by 2005, with the financial support of \$18,066,845 from the Multilateral Fund. Since the proposed sector plan involves conversion at two existing plants and the average implementation time frame of investment projects is approximately 3 years, the action should, therefore, be taken by the end of 2002 or early 2003 at the latest in order to ensure that the deadline of 2005 is met.

Moreover, since this project is submitted as a sector plan, the Government of India would like to request the Executive Committee to allow the Government of India with full flexibility on how these approved funds be utilized and distributed among all the four enterprise covered by this plan, providing that CTC consumption in this sub-sector is phased out as planned.

Chapter 2

Development of Chlorinated Rubber Market And Sub-Sector Profile

Development of Chlorinated Rubber Market in India and Other Article 5 Countries

Chlorinated rubber is a resin binder used as part of the formulations of paints and coating products, ink, adhesives, primers for oil and gas pipelines, coal tar coatings, fireworks and flares, and concrete curing components. Depending on the formulations used, approximately 16 – 20% by weight of chlorinated rubber is contained in those coating products. Common use of chlorinated rubber in these products is attributed to the following physical properties: water and chemical resistant properties, fast drying, ease of application, bonding property, and fire retardant property.

Table 3: Major products containing chlorinated rubber as part of their formulations

Application	Preferred Properties
Paints <ul style="list-style-type: none"> • Paints for marine and off-shore structures; • Industrial anti-corrosive paints; • Road marking paints; • Swimming pool paints; • Container paints; • Fire retardant paints; • Anti-fungal paints. 	<ul style="list-style-type: none"> • Water and chemical resistance; • Ease of application – recoating without much surface preparation and under any weather conditions; • Chlorine compound helps prevent fouling which is important for marine and hospital applications; • Fast drying is essential for road marking paints. It also provides long-lasting coating on concrete surface. • Fire retardant is preferable for paints for sensitive facilities like nuclear power plants and hospitals.
Ink <ul style="list-style-type: none"> • Rotogravure inks; • Screen inks 	<ul style="list-style-type: none"> • Fast drying is a key parameter for high speed and security printing. Major uses are inks for newspapers, packaging materials, stamps and currency notes, and other official documents and seals.
Adhesives <ul style="list-style-type: none"> • Footwear adhesives; • Rubber to metal bonding (automobile applications – engine mounting pads); • Hot melts; • Pressure sensitive. 	<ul style="list-style-type: none"> • Bonding property is a desirable feature of chlorinated rubber particularly for bonding between rubber and metal components.
Primers and coatings for coal tar for oil &	<ul style="list-style-type: none"> • Water and chemical resistance is

gas pipelines	preferable for this type of applications.
Fireworks/Flares	<ul style="list-style-type: none"> • Fire retardant is an important feature for controlling the combustion process of these types of products.
Curing of concrete for large construction sites – dams, expressways, and etc.	<ul style="list-style-type: none"> • Coating material containing chlorinated rubber is preferable in a large construction sites. This application is normally required when water supply is scarce. This product is applied to the surface of uncured concrete in order to form a coating layer to slow down the evaporation rate of the water from the uncured concrete. This helps improve the strength of the concrete, and minimize water requirement, which is critical to construction sites in remote areas.

All the applications mentioned above are common in both developed and developing countries. Among all the above applications, paints are the largest market for chlorinated rubber. Chlorinated rubber produced in India is, therefore, being supplied to both markets in Article 2 and Article 5 countries. The demand for this product in Article 5 countries during the last decade increased at a faster rate than the demand in Article 2 countries due to a significant increase in the development activities in Article 5 countries.

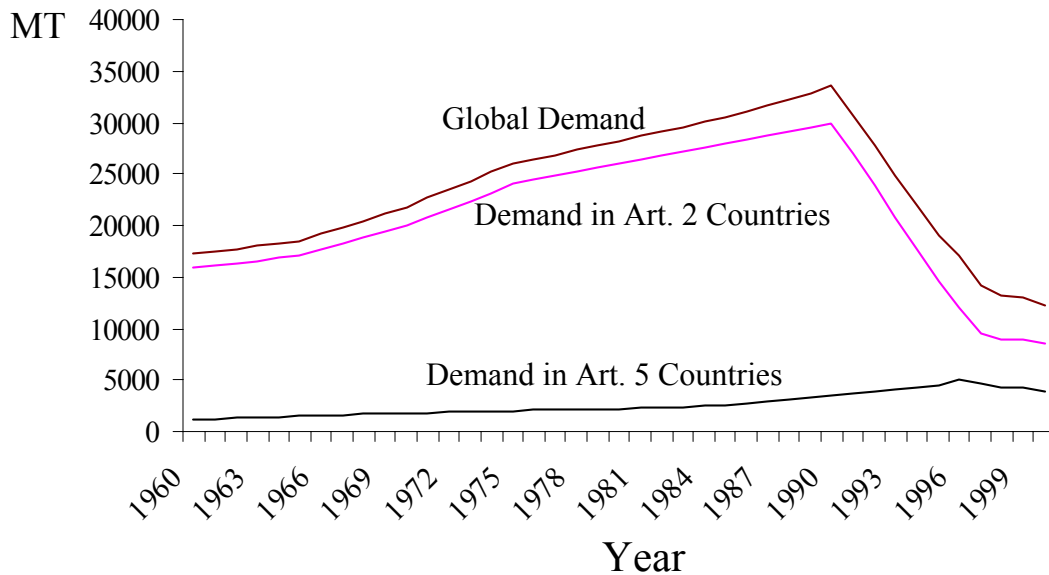


Fig. 1: Actual Global Demand of Chlorinated Rubber From 1960 – 2000.

The demand for chlorinated rubber in Article 2 countries had been increasing from about 15,000 MT in 1960 to about 30,000 MT in 1990. However, when the Montreal Protocol was established in late 1980s, the market of chlorinated rubber in Article 2 countries was seriously affected as shown by the sudden drop in demand starting from 1991 onwards. Chlorinated rubber producers in Article 2 countries that did not have technologies to reduce or replace CTC in their production process decided to shut down their operations. Because of the unavailability of CTC-free chlorinated rubber at that time, end users were compelled to change their formulations to alternatives such as polyurethane, epoxies or acrylics albeit at the cost of inferior performance in many applications.

While the total market of chlorinated rubber is expected to be more than 30,000 MT per year as applications for which chlorinated rubber is used has grown in correlation with the level of economic development, the current global capacity to supply non-CTC chlorinated rubber or chlorinated rubber with CTC content of less than 10 ppm, is less than 10,000 MT. This current capacity has only been available in mid 1990s. It has been recently reported that major producers in Article 2 countries are planning to set up a new non-CTC chlorinated rubber production facility with a capacity of at least 10,000 MT to capture the current significantly unmet demand.

The demand for chlorinated rubber in all Article 5 countries in 1970s was about 2,000 MT per annum. The demand of this product in India was projected to increase at an average rate of 18% during 1990s as reported by the TEAP 1997 Report. The conservative projection made by the coating industry indicates that the market for chlorinated rubber will grow 12% per annum or more during the next decade^{1 2}. Based on the historical data, it is expected that the demand for chlorinated rubber in Article 2 countries would continue to grow at a rate of 1.4% per annum during 2000s.

For example, the Indian Government announced in 1999 that extensive effort would be undertaken to upgrade, expand and build new expressways and highways throughout India. To meet this goal, the National Highways Authority of India (NHAI) has been charged with major responsibility together with that being taken up by the State Governments to improve and expand the road transportation system. The NHAI's plans include, among others, construction of four to six lane highways of about 14,000 km.

Development of this national infrastructure involves substantial increase in requirements of initial and annual recoating of these highways by road marking paints. The requirement of these marking paints will result in a sharp increase in demand for chlorinated rubber since chlorinated rubber is used in these products.

¹ Frost & Sullivan Analyst, *Indian Coating Markets*, September 2000.

² Frost & Sullivan Analyst, *Indian Inks Market – Part I*, October 2000.

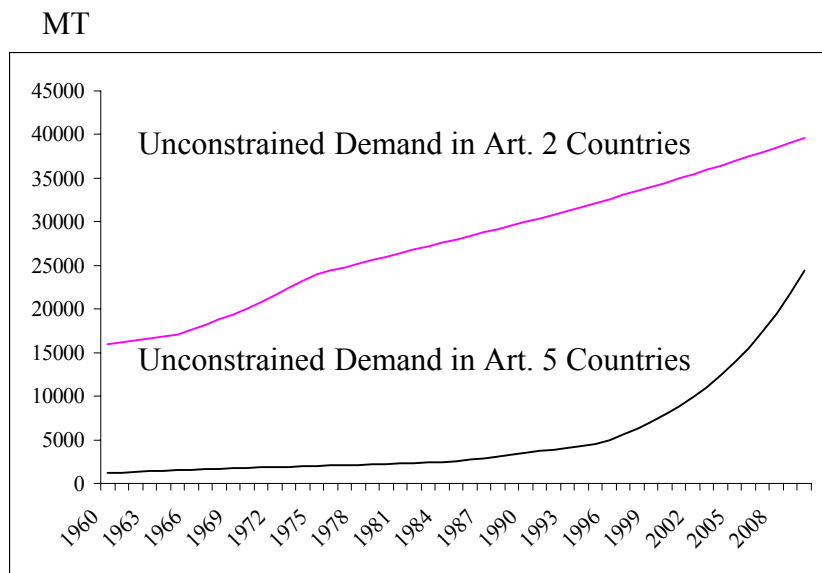


Fig. 2: Unconstrained demand of global market for chlorinated rubber.

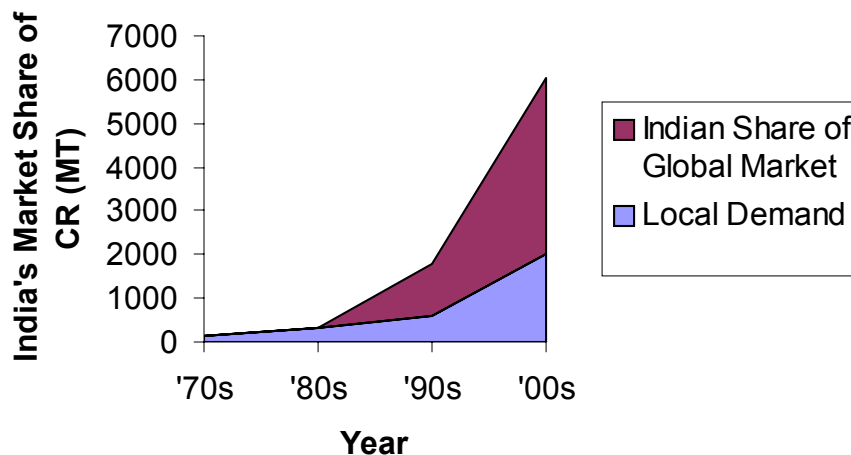


Fig. 3: Projected market share of Indian chlorinated rubber products

The total demand for chlorinated rubber in India in early 1970s was reported to be about 150 MT per year. This demand has continuously increased throughout the 1970s and 1980s. In 1996, the local demand of chlorinated rubber increased to about 600 MT. It was expected that the demand in India would continue to increase to 1,000 MT in 2000, and 2,875 MT in 2010. It was also expected that demand for this product would also increase in all other Article 5 countries. As shown in the above figure, the demand in all Article 5 countries was expected to reach the 8,000 MT level in 2000 (Fig. 2) and more than 34,000 MT in Article 2 countries. Since in early 1990s there were only a few chlorinated rubber manufacturers in Article 5 countries (two producers in India and one

in China), India, therefore, expected to capture an increasing portion of the global market share. The existing chlorinated rubber production capacity of 6,000 MT in India (Fig. 3) is only 14% of the projected demand for 2000.

Due to the Montreal Protocol, the global market outlook of chlorinated rubber containing CTC has been seriously affected. Excess production capacity for chlorinated rubber as currently experienced in India is a direct result of this phenomenon.

Sub-Sector Profile of the Indian Chlorinated Rubber Industry

There are five chlorinated rubber manufacturers in India, all of whom use CTC as a process solvent. Details of these enterprises are described below:

Table 4: Chlorinated Rubber Manufacturers in India

Serial No.	Enterprise	Start of commercial production	Installed capacity (MT/yr.)
1.	Rishiroop Polymers Pvt. Ltd. (RPL)	1973	550
2.	Pauraj Chemicals Pvt. Ltd.	1980	150
3.	Rishiroop Organics Pvt. Ltd. (ROL)	1991	550
4.	Rishiroop Rubber International Ltd. (RRIL)	1993	4500
5.	Tarak Chemicals Ltd.	1998	300

Chlorinated rubber production in India began in 1973 when Rishiroop Polymers Pvt Ltd. (RPL) installed the first production facility at Nasik. This first plant had an initial installed capacity of 150 MT per annum. The plant was de-bottlenecked in 1982 to increase production to 300 MT per annum and further expanded in 1988 to increase the installed capacity to the current level of 550 MT per annum on a three-shift basis. This expansion was required in response of the growing demand for chlorinated rubber products. The increasing demand of chlorinated rubber products had a direct correlation with the growth of economic development in developing countries.

Pauraj Chemicals set up its chlorinated rubber production facility at Tarapur in the State of Maharashtra in 1980. This second chlorinated rubber plant has a production capacity of 150 MT per annum.

Table 5: Chlorinated Rubber Production (MT) in India

<u>Financial</u> <u>Year</u> Enterprise	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01
TOTAL	597	735	639	1014	1293	1392	1262	1175	987	751

In response of the continuing growth of local demand for chlorinated rubber, Rishirop Group invested in its second plant with a 550 MT capacity at Vapi in Gujarat under the name Rishirop Organics Pvt. Ltd (ROL) in 1991. By 1991, the total production capacity of chlorinated rubber in India reached the 1,250 MT level. The actual demand and production of this product during the financial year 1992 – 1993 was 735 MT, exceeding the capacity of the first two plants (RPL and Pauraj). Therefore, the decision of Rishirop Group to set up a second plant (ROL) in 1991 was timely.

In mid1980s, other developing countries also experienced a noticeable growth in the demand of chlorinated rubber as experienced in India. It was projected that the demand for this product would reach the 10,000 MT level by 2000. To respond to this increasing demand and the high rate of economic growth in developing countries in 1990s, including the local economic reform policy adopted by the Government of India, the Rishirop Group decided to set up a third plant with a capacity of 4,500 MT. This capacity would be used mainly for meeting the growing demand in developing countries. It was anticipated that by 2000 the Indian producers of chlorinated rubber would have about 40 – 60% of the market in developing countries.

Based on this projection, the Rishirop Group applied for a factory license with the Ministry of Industry on September 10, 1990. At the time the application was submitted to the Ministry of Industry, India was not a Party to the Protocol. The Ministry of Industry approved the license for this new plant in April 1991 with a condition that 25% of the total production should be allocated for the local market while the remaining could be exported. The construction was completed and the commercial scale production at Rishirop Rubber (International) Ltd. (RRIL) started in 1993. The company is owned by about 20,000 shareholders, and its shares are listed in the Bombay Stock Exchange. It was anticipated that production capacity would be fully utilized by 2000.

While it was known in late 1990 immediately after the Meeting of the Parties in London that CTC was included as one of the new controlled substances under the Montreal Protocol, at that time, however, the Government of India had not ratified the Montreal Protocol until September 1992, and at that time there was no other commercially available alternative technology for the production of chlorinated rubber. RRIL, therefore, decided to proceed with its original plan by adopting the only available CTC-based technology. Without the construction of the new RRIL plant, part of the growing demand for chlorinated rubber would have to be fulfilled by imports as the total demand in the financial years, 1995 – 1996 and 1996 – 1997, already exceeded the combined capacity (1,250 MT) of ROL, RPL and Pauraj. If there were no Montreal Protocol, the

demand would have continued to grow in accordance with the market projection made in 1980s by the Indian chlorinated rubber industry.

In 1994, the Parties decided that for 1996 CTC consumption in the process agent applications should be treated akin to feedstock³. This exemption was further extended till 1998 at the Seventh Meeting of the Parties⁴. Because of these decisions, CTC used for the process agent applications was not considered as a controlled substance during 1996 – 1998. At the Tenth Meeting of the Parties, it was decided that CTC used for chlorinated rubber applications be reclassified under process agents as a controlled substance under the Montreal Protocol (Dec. X/14). Because of the labor dispute at RPL, the increasing demand of chlorinated rubber experienced in 1995 and 1996, and the fact that during 1996 – 1998 CTC consumed in the process agent applications was not considered as a controlled substance and was not subjected to any phaseout targets by the Montreal Protocol, Tarak started up its own production facility of 300 MT capacity in October 1998.

Based on Dec. X/14, the residual emission of CTC from enterprises in Article 5 countries that started their operations before 1 January 1999 will not be counted against their national consumption or production level if they reduce the emission level down to the level agreed by the ExCom. Dec. X/14 also states that incremental costs of a range of cost-effective measures should be eligible for funding in accordance with the rules and guidelines of the ExCom. All chlorinated rubber producers in India started their operations before 1 January 1999. Therefore, all of them are eligible for funding from the Multilateral Fund, including RPL that has its idle capacity installed long before 1 January 1999, and the idle capacity can be reactivated in a short time if there were no Montreal Protocol.

With regard to Dec. 17/7 of the ExCom which states that in the light of technological advances, the ExCom will not to consider any projects to convert any ODS-based capacity installed after 25 July 1995, it is obvious that this decision is not applicable to the chlorinated rubber sub-sector as no alternative technologies for this sub-sector were available before 25 July 1995.

In fact, only in 1996 when one German chlorinated rubber producer was able to successfully modify its plant to reduce emission of CTC from its process and its chlorinated rubber products. Similarly, a Japanese enterprise, which decided to opt for a non-CTC conversion option, was only able to complete its development of its new process and have it commercialized in 1997.

³ Decision VI/10

⁴ Decision VII/10

Chapter 3

Impact of the Montreal Protocol on The Global Market of Chlorinated Rubber

Impact of the Montreal Protocol on the Global Market of Chlorinated Rubber

The TEAP 1997 report states that almost 50% of world's chlorinated rubber production capacity of some 40,000 MT/year was shut down in early 1990s in UK and USA as chlorinated rubber produced by most producers could not meet the more stringent CTC content requirement. With limited supply of low CTC content chlorinated rubber, producers of end products such as paints and inks which normally used chlorinated rubber as a main ingredient, had to change formulation of 50,000 to 100,000 MT of end products to alternative resin binders such as polyurethane, epoxies or acrylics, even if product performance has to be compromised, in order to maintain and to meet the growing demand of these end products.

Many product lines (such as marine paints) are being sold in the international market and their specification is dictated by the global standard established by parent multi-national companies or technology providers in Article 2 countries. The immediate change in the product specification made by such multi-national companies in mid 1990s in order to meet the stringent requirement on the CTC content, has caused immediate change in the specification of products manufactured in Article 5 countries. Prior to the Montreal Protocol, chlorinated rubber with 5 – 7% CTC content of more than 1.17 million tons had been produced and accepted by end users for the last 50 years. Because of the Montreal Protocol, this product is no longer acceptable.

In mid 1990s, developed countries adopted stricter norms for use of products containing CTC, restricting the market of chlorinated rubber having CTC content more than 1% due to labeling requirements of end products. Due to corporate policies of technology providers for end products in developed countries, discrimination against chlorinated rubber with a high content of CTC was also applied to manufacturers of end products in developing countries, which are the major exporting markets of the Indian chlorinated rubber manufacturers. In addition, uncertainty of the supply of CTC and chlorinated rubber has also made manufacturers in developing countries switch to alternatives.

Under these circumstances the chlorinated rubber market was seriously affected. Sales of chlorinated rubber started to decline after mid 1990s as more and more customers desiring to use chlorinated rubber with CTC content of below 1%. Since there is one company in Article 2 country producing chlorinated rubber with a CTC content of less than 10 ppm, market acceptance has then become even more stringent. The 10 ppm CTC content chlorinated rubber has become an industrial norm since 1996. Due to non-availability of technology know-how and the large investment capital required for modifying the production process, Indian producers were unable to comply with this stringent specification. This has resulted in a significant drop in the total production of

chlorinated rubber in India as shown in Table 6. As a result, a large percentage of existing installed capacity in India was unutilized.

Table 6: Actual Production of Chlorinated Rubber as Percentage of Existing Installed Capacity

Financial Year	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00'01
Installed Capacity	1250	1250	5750	5750	5750	5750	5750	6050	6050	6050
Production	597	735	639	1014	1293	1392	1262	1175	987	751
Production as % to Installed capacity	48%	59%	11%	18%	22%	24%	22%	19%	16%	12%

In addition to the reduction of CTC content in the final products, chlorinated rubber manufacturers in India will soon be subjected to additional requirements from the Government of India to reduce the consumption by 85% of the baseline consumption by 2005 and eventually phase out any CTC emissions from the process by 2010.

The production of chlorinated rubber increased from 597 MT in 1991 – 1992 to 1,392 MT in 1996 – 1997. This represented a 133% increase in five years giving an average annual growth rate of 27%. The CTC consumption also increased from 343 MT in 1991 – 1992 to 878 MT in 1996 – 1997, a 147% increase in consumption (Table 7). This represented an average annual growth rate of 29%. The increasing consumption of CTC has a direct correlation with the increasing production level of chlorinated rubber as India's industrial norm of CTC consumption per MT of chlorinated rubber is approximately 0.63 MT of CTC per MT of chlorinated rubber.

Table 7: CTC Consumption (MT)

	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01
TOTAL	343	511	288	460	847	878	726	602	549	277

The chlorinated rubber production and CTC consumption in India would have continued to grow if there were no Montreal Protocol. The market pressure on chlorinated rubber containing CTC has depressed the global demand of this product. Because of the uncertainty of future supply of CTC and the more stringent requirement on the acceptable level of CTC in the final products, manufacturers of end products have converted to alternatives. While the demand for paints, inks, and those products that normally contain chlorinated rubber as part of their formulations, continues to grow as anticipated, the demand for conventional chlorinated rubber containing 3 – 7% of CTC is diminishing. Furthermore, the recent economic downturn in most developing countries has resulted in a further reduction in the demand of chlorinated rubber products. However, this factor is expected to be a short-term phenomenon.

India ratified the Montreal Protocol in 1992 and is obliged to phase out the use of CTC by 85% by 2005 and completely phase out by 2010. India's chlorinated rubber production has declined from 1,392 MT in 1996 – 1997 to 751 MT in 2000 – 2001. To preempt any further disruption in economic development in India, the Government of India would like to seek financial assistance from the Multilateral Fund to assist the Indian chlorinated rubber industry to undertake a smooth transition towards a complete phaseout of the use of CTC in the chlorinated rubber by 2005.

Chapter 4

Chlorinated Rubber Sub-Sector Strategy

The Government of India will phase out the use of CTC in the production of chlorinated rubber before 2005. The TEAP April 1997 report projected that CTC consumption in the chlorinated rubber sub-sector in India would be about 1,800 MT or 55% of the total projected quantity of CTC emissions in the process agent sector. This sub-sector strategy is part of the Government of India's overall action plan to meet its obligations under the Montreal Protocol with regard to the phaseout of Annex B, Group II chemical (CTC) – 85% reduction by 2005 and 100% reduction by 2010.

Major consumption of CTC in India is in the solvent and process agent sectors. However, the consumption of CTC in the solvent sector is scattering among a large number of small users. It is anticipated that meaningful phaseout of CTC use in the solvent sector will take a longer period to achieve. Moreover, the development of the sector strategy for the solvent sector is still being in a nascent stage. A final strategy for this sector is expected to be ready by next year at the earliest. Therefore, an accelerated phaseout schedule for the chlorinated rubber sub-sector is required in order to contribute to country's ability to meet the upcoming obligation in 2005. Since an average project implementation duration of investment projects is about 3 years, therefore, for the phaseout in this sub-sector to contribute to the national effort in meeting the 85% reduction target in 2005, implementation of CTC phaseout in the chlorinated rubber sub-sector should start, at the latest, at the end of 2002 or early 2003.

Regulatory Measures

Based on Rule 9 of the Ozone Depleting Substances (Regulation) Rules 2000, published in the Ministry of Environment and Forests' notification number S.O. 69 (E), dated January 25, 2000, no person shall establish or expand or cause to establish or expand any manufacturing facility, with a view to manufacturing products which contain, or are made with, any ozone depleting substance after July 19, 2000. In addition, all chlorinated rubber producers in India are registered with the Ozone Cell, Ministry of Environment and Forest, in accordance with Rule 13 of the Ozone Depleting Substances (Regulation and Control) Rules 2000. The registration numbers for the five enterprises eligible for funding from the Multilateral Fund are listed below:

Table 8: Registration Numbers of Chlorinated Rubber Producers

Enterprise	Registration Number
Rishirop Polymers Pvt. Ltd.	ODS/CS/17/2(23)/2001
Rishirop Rubber International Ltd	ODS/CS/17/2(22)/2001
Rishirop Organics Pvt. Ltd.	ODS/CS/17/2(21)/2001
Pauraj Chemicals Pvt. Ltd.	ODS/CS/17/2(54)/2001
Tarak Chemicals Ltd.	ODS/CS/17/2(36)/2001

The above rule will ensure that the implementation of this chlorinated rubber sub-sector plan will result in a permanent reduction of CTC from India's national aggregate consumption.

Cost Models for CTC Emission Reduction Options

The chlorinated rubber sub-sector phaseout strategy is developed on the basis of the cost-effective CTC emission abatement/phaseout measures specified by the Parties (Decision X/14). These cost-effective measures include process conversions, plant closures, emission control technologies, and industrial rationalization. Practicality of each of these options is examined under the current state of technology development and the existing technology absorption capacity within the country.

Option 1: Process conversions

It is important to note that the actual cost of conversion of chlorinated rubber plants could vary significantly depending on the conditions of the existing baseline equipment and the baseline process employed. Moreover, alternative technologies for chlorinated rubber have only recently emerged. There are only two known sources of alternative technologies. Due to the lack of experience with regard to these new technologies, it is extremely difficult to estimate on what the actual cost for conversion at each enterprise would be. Depending on which types of technologies and/or technology providers the enterprises will have an access to conversions may involve modifications of existing plants or rebuild the whole new plants, and additional costs will be required for technology licenses and fees. Moreover, not all existing plants will be able to access to the new non-CTC technologies. However, for the purpose for the development of cost-benefit analyses for all options recommended by the Parties of the Montreal Protocol, an estimate is made on the basis of the funding level approved by the Multilateral Fund for the ROL project (the only chlorinated rubber project that has been approved by the Multilateral Fund to date). Therefore, this estimate should be considered as indicative only.

Table 9: Indicative Cost of Option 1 – Conversion at the four enterprises

	Installed Capacity (MT of CR)	Average CTC Consumption per year (MT/year)	Incremental Capital Cost (\$)	Incremental Operating Cost (\$)	Sub-Total (\$)
Total	5,500	475.66	20,287,230	230,901	20,518,131

The cost of conversion of the 5,500 MT installed capacity to non-CTC alternative technology is approximately \$20.52 million assuming that alternative technology is available to all enterprises. With the overall export component to Article 2 countries of 30.38%, as shown in Annex II, the eligible cost of conversion of the whole chlorinated

rubber sub-sector, after deduction of export component (30.38% minus 10%) becomes \$16,336,536.

It is important to note that the actual cost of conversion, particularly for smaller factories, may likely be more expensive as unit cost of smaller plant capacity is normally higher. Depending on the existing process and plant design, some plants may require complete replacement of all existing equipment. Furthermore, the cost estimate provided in this document is based on a similar technology to be employed by ROL. If the cost calculation is based on available technology in Article 2 countries, the final cost estimate could have been higher by 200 – 300%. This statement is made on the basis of the following information:

Solvent Exchange Process (Emission Abatement)⁵: A German enterprise has adopted a two-stage procedure to reduce the emissions from its process and to eliminate the CTC contained as impurity in its chlorinated rubber products. It was reported that:

- (a) The German enterprise spent about \$25 million to reduce the emissions in its 7,000 TPA capacity plant from a level about 430 MT in 1989 to a level of about 0.3 MT in 1996. It took 7 years of intensive efforts to bring the emissions down to this level;
- (b) In addition, this enterprise has spent about \$40 million to modify its plant to reduce the impurity of CTC from its product, which was eventually being emitted to the atmosphere in the end use. This was done by adopting its own recently patented process for the solvent exchange;
- (c) Furthermore, the German enterprise has stated that it is incurring an incremental operating cost for environmental operation of its plant of \$0.8 million per year.

Non-ODS Japanese Process: A Japanese enterprise has developed a non-ODS process for chlorinated rubber and commercialized it in 1997. According to news reports the Japanese process costs the company an investment of about one billion Yen, approximately \$10 million in order to set up a production facility of 800 MT of chlorinated rubber per annum. This option is clearly expensive and not cost-effective (a brief write-up on this subject from Japan Chemical Weekly (J.C.W. April 20, 1995 is available in the project file of the World Bank). RRIL, one of the beneficiaries of this sub-sector plan, had been in contact with this Japanese company, but an agreement for licensing its patent did not materialize due to conditions set up by the Japanese company for licensing of the process to RRIL. The conditions include high cost of technology transfer, royalty and operational restrictions regarding sales of non-ODS chlorinated rubber in specific markets, etc., which made it practically inaccessible to RRIL.

Estimation of Cost of Emission Reduction for Chemical Process Agents: The Process Agent Working Group constituted by TEAP reported in its May 1995 report (Annex 5) that to reduce emission from a 4,000 – 5,000 tons per annum of a chlorinated rubber plant

⁵ Paper presented by Dr. Kerres, a member of PATF, at a workshop organized by ICMA in Mumbai, January 1997.

to an insignificant level will require a capital investment of about \$70 - \$100 million. It is clear then that this alternative is expensive and has other limitations as it presents an interim solution and an eventual conversion to a non-ODS process will be required later.

Option 2: Plant closures

The second scenario is to assume that all four enterprises opt for a closure option. To calculate the level of compensation, a financial model similar to the one used for the CFC production closure project for India is used. Profit streams foregone due to early closure of these facilities are calculated on the basis of unconstrained growth, which would be expected if there were no Montreal Protocol.

The actual selling price of chlorinated rubber (which is as competitive as international prices), variable costs and fixed costs in the baseline year, the financial year 1996 – 1997 are used for determining income and costs at various levels of projected production in subsequent years till the year 2010.

The baseline production level of the four enterprises is established by using the average combined production of these plants during the three financial years: 1995 – 1996, 1996 – 1997, and 1997 – 1998. Without the Montreal Protocol, the demand and production would have continued to increase at a rate experienced prior to the 1995 – 1996 financial year. However, for the purpose of this proposal, a growth rate of 12% per annum (as stated earlier in Chapter 2) for both the local and exporting markets in Article 5 countries is applied to the model.

In addition, a 3% annual inflation rate is applied over the period from 1996 – 2010. This model employs a discount rate of 7% per annum, similar to the CFC production closure project. For more detailed information pertaining to the financial model, please refer to Annex III.

Based on these key parameters, the total amount of profits forgone by early closure of these four remaining chlorinated rubber plants is projected to be \$35,573,923 after deducting 20.38%. (The average level of export to Article 2 countries is 30.38%. Based on the ExCom guidelines, the funding level should, therefore, be reduced by 20.38%.) Distribution of the foregone profits is determined on the basis of the installed capacity of each enterprise. The distribution of foregone profits is shown in Annex III.

Table 10: Foregone Profits Induced by the Montreal Protocol

	Installed Capacity (MT of Chlorinated Rubber)	Forgone Profits (\$)
Total	5,500	35,573,923

The Supreme Court of India has issued a ruling requiring that compensation for labor redundancy resulting from closure of business on environmental grounds be a minimum of six years' annual salary and admissible benefits. The total number of jobs lost as a

result of plant closure is estimated to be 205, corresponding to a total labor compensation package of \$1,857,600.

Therefore, the total cost for the closure option is the sum of profits foregone and labor compensation. This amounts to \$37,431,523.

Option 3: Emission Abatement Technologies

An emission abatement system in principle consists of devices for collection, treatment, recovery, disposal, emission and quality control. This can be applied for various applications, including soil conservation, water purification, and air/vapor purification or recycling. An emission abatement system is characterized overall by strict control of operations, with detailed attention on operations. A large number of valves and joints in the plant need to be controlled for emissions/leakage; pumps and sealing systems of the reactors also need to be modified or replaced for sealing. Finally, it is also sensitive to power fluctuations/outage, which can lead to higher emissions of CTC.

Depending on the baseline equipment and the types of processes employed, an emission abatement system including maintenance practices could vary significantly. In certain cases, an emission abatement option may involve major plant overhaul. Therefore, costs of an emission abatement system could vary significantly. In certain cases, this may not even be a technically and financially feasible option.

The incremental capital cost of the emission abatement system of a 550 MT capacity at ROL has been previously worked out to be \$2,199,230. The incremental operating cost of the same facility (NPV for four years) was worked out at \$779,636. This provides a total cost for emission abatement of a 550 MT plant equal to \$2,978,866. This estimate does not include the cost of licensing of technology or engineering consultancy charges over the period of commissioning of the emission abatement system. Such costs would have to be added to the incremental investment cost of this option.

With an emission abatement system alone, enterprises will not be able to completely phase out the use of CTC. Additional purification systems must be put in place in order to remove and recover CTC that is entrapped in the final product. Failure to do so will result in having about 3.5% of CTC used on chlorinated rubber remain in the product and eventually being emitted to the atmosphere. Furthermore, the product with this level of CTC content has become increasingly unacceptable as customers are discriminating against chlorinated rubber with a CTC content of more than 10 ppm. Finally, even if the Indian chlorinated rubber producers decide to exercise this option, they will not be able to do so because they do not have access to the product purification technology.

Therefore, the emission abatement technologies are clearly not an option for the Indian chlorinated rubber producers.

Option 4: Industrial Rationalization

As pointed out in Option 1 not all enterprises will be able to access the new non-CTC chlorinated rubber production technologies. Therefore, Option 1 scenario is not feasible. Similarly, Option 2 scenario, requiring that all chlorinated rubber producers in India completely stop their production, is also not desirable, as it would create abrupt disruption of the economic development of India.

Emission abatement option requires a long period for development and stabilization, and even in non-Article 5 (1) countries such systems are more effective only in large units with concerted efforts stretching over 10 years or more and involving large expenditures. Operation of these systems requires uninterrupted power supply, highly skilled manpower for preventive maintenance and upkeep of plant facilities and sustained training and experience. Frequent power disruptions and consequent malfunctioning of abatement systems will, in fact, lead to higher emissions. Such conditions are difficult to achieve in Article 5 countries.

The emission abatement system does not resolve the problem of substantial quantity of residual CTC in the end product. Installation of a solvent exchange system to get over this problem is extremely costly and the required technology is not available. Finally, adoption of emission abatement is at best an interim solution and continues to rely on CTC.

It is, therefore, considered much more desirable for India to undertake conversion at the two facilities that have access to the new non-CTC alternative technology, while the remaining producers have already decided to opt for a closure option. The total cost of \$18,066,845 for the industrial rationalization option includes costs of conversion at RRIL and RPL, costs of closure plus labor compensation for Pauraj and Tarak. With this level of funding, India will be able to completely phase out the use of CTC in this sub-sector without causing any disruption to its economic development.

Table 11: Incremental Cost of Option 4

	CTC Phaseout Option	Incremental Cost (\$)
Conversion at two plants	Conversion	14,538,898*
Closure at two plants	Closure	2,909,947*
Labor Compensation for two plants		618,000
Total		18,066,845

*Incremental cost after export deduction of 20.38 % (30.38% minus 10%) to Article 2 countries.

Summary

The costs of various options described above is summarized below:

Table 12: CTC Phaseout Costs for the Four Options Approved by the Parties

Option	Incremental Cost (\$)	CTC Phaseout (MT)	Cost Effectiveness (\$/kg ODP)
Conversion	16,336,536*	347	\$42.80
Closure	37,431,523	347	\$98.07
Emission Abatement	Not applicable	325.25**	
Industrial Rationalization	18,066,845	347	\$47.33

*Detailed cost calculation is provided in the project proposals for conversion of chlorinated rubber facility at RRIL and RPL. These proposals are attached as Annex VI of this document.

**Assuming that CTC emission during the process reduces to zero. CTC emissions are caused by the residual quantity of CTC entrapped in the final products (3% of the weight of the product).

Proposed Strategy

The Government of India and the chlorinated rubber producers in India agree to opt for Option 4 as their strategy for phasing out CTC consumption in this sub-sector. Based on this option, two enterprises that have access to a new non-CTC alternative technology will undertake conversions immediately after the Executive Committee approves the funds to support this strategy, and when the ROL facility, which is also funded by the Multilateral Fund, completes their non-CTC chlorinated rubber production conversion and becomes on-line.

Based on the historical data, the market of CTC chlorinated rubber has declined at a rate of 16 % per annum due to the Montreal Protocol. However, the demand for end products is growing at the rate of 12% per annum from 2002 to 2004. The demand in 2005 is further limited by the 85% reduction of CTC consumption. The declining market of CTC chlorinated rubber is being replaced by non-CTC chlorinated rubber and substitutes such as polyurethane, epoxies and acrylics.

Table 13: Projection of the Total Demand of Chlorinated Rubber and Alternative

Year	Residual Demand for CTC chlorinated rubber (with MP) (MT)	CTC chlorinated Rubber Market that is Replaced by Substitutes (MT)	Total Demand for End Products (MT)
2002	631	1,581	830
2003	530	1,454	1,984
2004	445	1,777	2,222
2005	171	2,317	2,488

Conversion and Closure Sequence: To preempt a significant shortfall of the supply of CTC chlorinated rubber a conversion and closure sequence of the four remaining producers must be carefully designed. Conversion and closure at the same time will create a sudden shortage of chlorinated rubber, which is not desirable.

Conversion and closure sequence shown as Option A in Annex V shows that by undertaking conversions at RRIL and RPL in 2003 or immediately after the approval of this proposed sub-sector plan, India will be able to optimize the contribution of this sub-sector plan to country's ability to meet the 85% reduction target for CTC and to minimize the shortfall of chlorinated rubber supply during the transition period from 2003 – 2005. Moreover, this option will enable India to recapture its previous years market that was taken away by non-CTC chlorinated rubbers and other substitutes. As shown by Option B, delaying the conversion at RRIL and RPL will result in a higher shortfall of the supply of chlorinated rubber during the transition period. In addition, this option will take India beyond 2005 before it can recapture its lost market.

The Government of India, therefore, proposes to convert and close the remaining production of CTC chlorinated rubber in accordance with Option A presented in Annex V.

Implementation Timeframe

The Project will be implemented by the CR producers in India. The proposed implementation schedule illustrated below becomes effective after the OTF grant is made available. The change over from the existing plant will entail a production shutdown of about 12 months.

IMPLEMENTATION SCHEDULE

	QUARTERS											
	Year 2002				Year 2003				Year 2004			
	1	2	3	4	1	2	3	4	1	2	3	4
MF Project Approval			X									
Financial Appraisal				X								
Sub grant Agreement				X								
Equipment specification preparation					X	X						
Equipment procurement						X	X					
Installation of equipment							X	X				
Civil work						X	X	X				
Testing and trials									X	X		
Production Start-up							X	X		X	X	
Project completed												X
Plant Closure at Tarak and Pauraj											X	X
First Disbursement					X							
Final Disbursement												X
Completion Report.												X

Annex I CTC Consumption

Chlorinated Rubber Manufacturers in India

Serial No.	Enterprise	Start of commercial production	Installed capacity (MT/yr.)	CTC consumption (MT/yr)	Process agent (CTC MT) inventory in plant equipment when inspected (Dec. 1999)
1.	Rishiroop Polymers Pvt. Ltd. (RPL)	1973	550	(300)*	65.0
2.	Pauraj Chemicals Pvt. Ltd.	1980	150	82	26.0
3.	Rishiroop Organics Pvt. Ltd. (ROL)	1991	550	226	65.0
4.	Rishiroop Rubber International Ltd. (RRIL)	1993	4500	544	400.0
5.	Tarak Chemicals Ltd.	1998	300	164	50 (estimated)

*Projected consumption based on production records prior to the labor strike.

Breakdown of CTC Consumption (MT) at Each Chlorinated Rubber Producers in India

	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01
RRIL	-	-		184	625	575	456	346	352	130
ROL	52	227	12	7	141	262	221	196	123	69
RPL	222	223	219	235	31	0	0	0	0	0
PAURAJ	69	61	57	57	50	41	49	36	36	10
TARAK						-	-	24	38	68
TOTAL	343	511	288	483	847	878	726	602	549	277

Average CTC consumption in last three years excluding ROL = 347 MT

Annex II

Cost Calculation for Conversion Option

The approved capital cost for the ROL project before applying 20% reduction on technology upgrade, is \$2,284,742. This amount includes contingency of \$155,968. In addition, the Multilateral Fund also approved a one-year incremental operating cost of \$109,906. This funding level is for supporting the conversion of a 550 MT production capacity. The average CTC consumption during the period from 1996 – 1998 is 226.203 MT.

Enterprise	Approved Incremental Capital Cost (\$)	Technology Fee (\$)	Installed Capacity (MT of CR)	Approved Capital Cost per MT of installed capacity (\$/kg of CR)*	Approved Incremental Operating Cost for 344.33 MT CR production (\$)	Approved Incremental Operating Cost per MT of CR produced (\$/MT CR)
ROL	2,140,987	238,000	550	3.46	109,906	316.84

*Excluding technology fee.

By taking the approved costs for the ROL project (\$3.46/kg of installed capacity and \$0.31684 /kg CR) plus a 10% contingency provision as standard costs, the conversion costs for the remaining four chlorinated rubber plants can be calculated as follow:

Production of Chlorinated Rubber during the past three years

Enterprise	1998 – 1999	1999 – 2000	2000 - 2001	Avg. Level of Production (MT)	Avg. Level of Export to Art. 2 Countries
RRIL	686	496	338	507	283
ROL	336	238	165	246	0
RPL	0	0	0	0	0
Pauraj	112	90	33	78	0
Tarak	41	163	215	140	12
Total	1,175	987	751	971	295

CTC Consumption (MT) during the past three years

	1998 -1999	1999 - 2000	2000 - 2001	Average CTC Consumption (MT)
RRIL	346	352	130	276
ROL	196	123	69	129
RPL	0	0	0	0
PAURAJ	36	36	10	27.33
TARAK	24	38	68	43.33
TOTAL	602	549	277	475.66

Export of Chlorinated Rubber to Non-Article 5 Countries during the last three years

Enterprise	1998 – 1999	1999 – 2000	2000 - 2001	Avg. Level of Export to Non-Art. 5 Countries (MT)
RRIL	415	255	178	283
ROL	0	0	0	0
RPL	0	0	0	0
Pauraj	0	0	0	0
Tarak	0	10	25	12
Total	415	265	203	295

The export component of the overall chlorinated rubber sub-sector is calculated on the basis of the average production level and the level of export to Article 2 countries during the period of 1999 – 2001.

For RRIL and RPL, conversion costs are determined on the basis of actual costs. The detailed cost breakdown for conversion at these two enterprises is shown in Annex VI, Parts A and B.

Enterprise	ICC (\$)	Contingency (\$)	IOC (\$)	Total
RRIL	14,109,530	1,376,553	161,829	15,647,912
RPL	2,396,588	215,859	0	2,612,447

For Pauraj and Tarak, which do not have access to new non-CTC alternative, estimate for the conversion option is carried out as follow:

Enterprise	Installed Capacity (MT of CR)	ICC* (\$)	Technology Fee (\$)	Total ICC (\$)
Pauraj	150	519,000	238,000	757,000
Tarak	300	1,038,000	238,000	1,276,000

*ICC does not include technology fee.

Enterprise	ICC (\$)*	Contingency (\$)*	Production Level (MT of CR)	IOC (\$)	Total (\$)
Pauraj	757,000	51,900	78	24,714	833,614
Tarak	1,276,000	103,800	140	44,358	1,424,158

*It is estimated that the actual conversion costs, without the technology fee, for Pauraj and Tarak are approximately \$1 million and \$1.7 million, respectively.

*No contingency provision for technology fee.

Summary :

Incremental Capital Costs	\$ 18,539,118
Contingency	\$ 1,748,112
Sub-total	\$ 20,287,230
Incremental Operating Costs	\$ 230,901
Sub-total	\$ 20,518,131
Export to Article 2 Countries (30.38%)	\$ (4,181,595)
Total Eligible Grant Amount	\$ 16,336,536

With the average production level of 971 MT and the average level of export to Article 2 countries of 295 MT during the corresponding period, the component of export to Article 2 countries is equal to 30.38%. Therefore, the incremental cost should be reduced by 20.38% (30.38% minus 10%, in accordance with the ExCom decision). After deducting the export component, the total eligible cost for this option becomes \$16,336,536.

Annex III Cost Model for Plant Closure Option

Methodology for Calculating the Compensation Level Under the Closure Option

A financial model is developed for determining the level of profit foregone in case the chlorinated rubber manufacturers decide to opt for an early closure of their facilities. Assuming that there was no Montreal Protocol, unconstrained growth in the demand and production of chlorinated rubber with CTC would have been expected.

To calculate streams of profit foregone by the chlorinated rubber producers due to early phaseout of chlorinated rubber production, actual selling price, variable and fixed costs in the baseline year (the financial year 1996 – 1997), are used. Projected income and costs are determined on the basis of unconstrained growth until the year 2010.

The followings are key parameters employed by this financial model:

Installed Capacity

The installed capacity as reported by each enterprise is listed below. This listed capacity is calculated on a basis of 3 shifts a day.

Enterprise	Installed Capacity (MT of Chlorinated Rubber)
RRIL	4,500
RPL	550
Pauraj	150
Tarak	300
Total	5,500

Baseline Production

The annual production levels during the three consecutive financial years (1995 – 1996, 1996 – 1997, and 1997 – 1998) are used for establishing an average annual production level or baseline production level. With this assumption, the baseline production level is 1,005 MT.

Baseline Year

The financial year of 1996 – 1997, starting from April 1996 to March 1997, is used as a baseline year. Sales price and other costs prevailing during this financial year are used as a basis for calculating costs and income in the subsequent years.

Growth Rate

The market experts projected that considering the economic downturn experiencing in India and other developing countries the demand of paints and inks will grow at a rate of about 12% from 2001 onwards. This growth rate is used in this model in order to calculate streams of profit forgone by the enterprises. This 12% rate is applied from 1996 – 2010. This rate is considered to be conservative as the actual growth rate during the period of 1990 – 1996 was reported to be at the level of 27% per annum.

Sales Price

The selling price is based on actual export price realized by Indian producers plus 10% in order to arrive at an international price of chlorinated rubber during the baseline year (1996 – 1997). In the subsequent years, the sales price is increased by 3% to account for the inflation rate.

Variable Costs

Variable costs consisting of raw material cost, utilities costs, effluent treatment costs, and labor costs, are also adjusted by 3% a year to account for the inflation rate.

Material Costs

The two important items that are imported by chlorinated rubber producers in India are CTC and synthetic rubber. The international prices of these two items have been taken at actual import cost (CIF price) while local prices for other items like chlorine, stabilizers, and etc., are used in this model as these items are purchased locally. The quantities of raw materials used for different production levels are calculated by using the standard consumption norms.

Utility Costs

These consist mainly of cost of electricity and furnace oils. The costs of these items are calculated on the basis of the rates prevailing in the local market.

Selling Expenses

These expenses represent the cost of shipping and handling of the final products. A flat rate charge of 6% of the selling price is used for this model.

Salaries and Wages

These costs are based on the actual costs in the baseline year. Costs for subsequent years are adjusted by 3% in order to account for inflation.

Fixed Overheads

These consist mainly of administrative overheads and are based on actual overheads incurred in the baseline year. Overhead costs for subsequent years are also adjusted by 3%.

Net Present Value (NPV)

The net present value of the foregone profits are calculated by applying a 7% discounting rate on the profit stream prior to deduction of interest and depreciation.

Based on the above parameters, the followings are the foregone profits to be experienced by each enterprise if it decides to opt for a closure option.

Enterprise	Installed Capacity (MT of Chlorinated Rubber)	% of Market Share	Forgone Profits (\$)
RRIL	4,500	81.82	36,556,875
RPL	550	10	4,467,963
Pauraj	150	2.73	1,219,754
Tarak	300	5.45	2,435,040
Total	5,500	100	44,679,632

Labor Compensation

The annual man-power costs for these enterprises are as follows:

Enterprise	No. of Employees	Annual Cost of Salary and Benefits
Rishiroop Polymers	15*	39,600
Rishiroop Rubber International	120	167,000
Pauraj Chemicals	30	41,000
Tarak Chemicals	40	62,000
Total	205	309,600

*Rishiroop Polymers had about 85 employees and annual man-power cost was about \$81,000 at the time of the labor dispute leading to temporary suspension of work.

Pursuant to the decision of the Indian Supreme Court, the compensation to be paid for labor redundancy resulting from closure of business on environmental grounds must be a minimum of six years of annual salary and admissible benefits.

There the total labor compensation for closing down these four enterprises amounts to \$1,857,600.

Analysis for Profits Foregone Due to the Montreal Protocol and Early Closure

	QTY (M.T. / CR)	UNIT RATE PER M.T. (US \$)	COST PER M.T. of CR (US\$)
PRODUCTION IN M.T. SALES PRICE (PER M.T./ CR)			
SALES (value) (A)		*	4125.00
			4125.00
LESS : VARIABLE COST			
MATERIAL COST			
CTC	0.631 *	450.00	283.95
SYNTHETIC RUBBER	0.38 *	1275.00	484.50
LIQUID CHLORINE	1.2	0.09	108.00
STABILIZER	0.01	1.22	1.22
CATALYST 1	0.00138	0.003	0.004
CATALYST 2	0.00043	0.009	0.004
PACKING COST		37.40	37.40
UTILITIES COST			
CONSUMABLE STORES		92.02	92.02
POWER (KWH)	3158	0.07	209.67
FURNACE OIL	1100	0.14	151.05
EFFLUENT TREAT EXPENSES	0.275	0.04	0.01
(B)		1855.99	1367.83
EXPORT CHARGES (C)		247.50	247.50
TOATL VARIABLE COST (D = B + C)		2103.49	1615.33
CONTRIBUTION (E = A - D)		2021.509	2509.67
		* Based on International Prices Other items are based on Local Prices	
LESS : FIXED EXPENSES			
FIXED OVERHEADS (F)			619.48
Depreciation			
Net Profit before Tax			
Tax			
Net Profit after Tax			
Depreciation			
Cash accruals			
Cash accruals			1890.19
NET PRESENT VALUE @ 7%			

Annex IV

Cost Model for Industrial Rationalization Option

As it is more desirable for India to undertake conversion at the two facilities that have access to the new non-CTC alternative technology, while the remaining producers will opt for a closure option, the cost estimate for this model is, therefore, the sum of the costs of conversion at RRIL and RPL, and the closure costs for Pauraj and Tarak. The closure cost will have to include a labor compensation for the corresponding plants.

Enterprise	Installed Capacity (MT of Chlorinated Rubber)	% of Market Share	CTC Phaseout Option	Incremental Cost (\$)*
RRIL	4,500	81.82	Conversion	15,647,912
RPL	550	10	Conversion	2,612,447
Pauraj	150	2.73	Closure	1,219,754
Tarak	300	5.45	Closure	2,435,040
Total	5,500	100		21,915,153

*Export deduction of 30.38-10.00 % is excluded.

The export deduction for the entire sub sector will be USD 4,466,308 and the eligible grant amount works out to USD 17,448,845.

Enterprise	Labor Compensation (\$)
Pauraj Chemicals	246,000
Tarak Chemicals	372,000
Total	618,000

Taking into account the labor compensation of USD 618,000 for Pauraj and Tarak, the total cost for industrialization option works out to USD 18,066,845.

Therefore, the total cost for the industrial rationalization is equal to \$18,066,845.

Annex V
Conversion and Closure Sequence

Option A*

					TOTAL	CR/CTC	CR/CTC	CR/CTC	TOTAL	TOTAL	GAP**
YEAR	RRIL	RPL	PAURAJ	TARAK	SUPPLY	DEMAND	GAP	FREE	SUPPLY	DEMAND	
2003	Conv.	Conv.	150	300	450	530	80	1454	450	1984	1534
2004	Conv.	Conv.	150	300	450	445	-5	1777	450	2222	1772
2005	4500	550	0	0	5050	171	-4879	2317	5050	2488	-2562

* All figures are in metric tons per year.

** Plus means unmet demand while minus means surplus.

Option B*

					TOTAL	CR/CTC	CR/CTC	CR/CTC	TOTAL	TOTAL	GAP**
YEAR	RRIL	RPL	PAURAJ	TARAK	SUPPLY	DEMAND	GAP	FREE	SUPPLY	DEMAND	
2003	530	Conv.	0	0	530	530	0	1454	530	1984	1454
2004	445	Conv.	0	0	445	445	0	1777	445	2222	1777
2005	Conv	550	0	0	550	171	-379	2317	550	2488	1938

* All figures are in metric tons per year.

** Plus means unmet demand while minus means surplus.

Annex VI
Detailed Project Proposal

**37th MEETING OF THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR
THE IMPLEMENTATION OF THE MONTREAL PROTOCOL**

Annex VI Part A

COUNTRY:	India
IMPLEMENTING AGENCY:	World Bank
PROJECT TITLE:	Conversion of Chlorinated rubber manufacture from Carbon Tetra Chloride to non-ODS process at Rishiroop Rubber International Ltd India.
PROJECT IN CURRENT BUSINESS PLAN:	Yes
SECTOR:	Solvents
SUB-SECTOR:	Process agents
ODS USE IN SECTOR:	Baseline (1999-2001) 304 ODP tons Current (1997) 7876 ODP tons (total CTC Consumption in 1997 as reported to the MP Ozone Secretariat)
PROJECT IMPACT (ODS TO BE ELIMINATED):	Projected Phase out 276 MT CTC (304 ODP tons)
PROJECT DURATION:	24 months
PROJECT COSTS:	
Incremental Capital Costs	US\$ 14,109,530
Contingency (10%)	US\$ 1,376,553
Incremental Operating Costs (NPV for 1 year)	US\$ 161,829
Total Project Cost	US\$ 15,647,912
LOCAL OWNERSHIP:	100%
EXPORT COMPONENT:	
REQUESTED GRANT:	Part of Sector Plan
IA SUPPORT COST:	Part of Sector Plan
TOTAL COST TO MLF:	Part of Sector Plan
COST EFFECTIVENESS:	Part of Sector Plan
PROJECT MONITORING MILESTONES INCLUDED:	Yes
NATIONAL COORDINATING AGENCY	MoEF, National Ozone Unit

PROJECT SUMMARY

This project will lead to elimination of the use of 276 MT per year (304 MT ODP) of Carbon Tetra Chloride in the manufacture of Chlorinated Rubber by Rishiroop Rubber International Ltd. The proposed proprietary technology to be adopted has been developed in house by the enterprise using a non-ODS media for the chlorination reaction and is non-transitional.

Prepared by: Indian Chemical Manufacturers Association and the World Bank
OORG review by: William Kenyon

Date: March 21, 2002
Date: April 22, 2002

1. PROJECT OBJECTIVES

The objective of this project is to completely phase out the use of Carbon Tetra Chloride (CTC) as a process solvent in the production of Chlorinated Rubber (CR) by Rishiroop Rubber International Ltd-Ankleshwar. (RRIL). The installed capacity of the present production facility is 4500 MT per year and it is proposed that this capacity be converted.

The implementation of this project will contribute to helping India to meet its obligations to phase out use of Ozone Depleting Substances (ODS).

2. SECTOR BACKGROUND

The detailed information on the process agent sector is included in the main document.

3. DESCRIPTION OF PRODUCTION FACILITIES

RRIL is a 100% Indian owned public limited company, and was incorporated in 1990. Its shares are listed on Bombay stock exchange and it has about 20,000 shareholders. The company is promoted by Rishiroop group. It has production facility for manufacture of CR at Ankleshwar in the state of Gujarat. During the last three fiscal years RRIL exported on an average 55.7 % of its production to non- article (5) countries during 1998-2001.

The Ankleshwar production facility started commercial production of CR in 1993 with an installed capacity of CR of 4,500 MT per annum on three shift basis. In the fiscal year 1996-97 RRIL had achieved highest CR production of 966 MT. Since then the production sales have been decreasing due to constraint on the sale and use of products containing ODS. It presently employs 120 persons at the plant .

It uses CTC as an inert solvent in the manufacture of CR. The conventional process for production of CR involves using CTC as a solvent medium for chlorination of the rubber. The dry rubber is first dissolved in CTC, and this rubber solution is reacted with chlorine gas to produce chlorinated rubber, which stays dissolved in CTC. The solvent CTC is then recovered from this CR solution by flashing it in hot water and recycling it. Because CTC is required to be used as a process solvent and is handled in large quantities, the process causes emissive losses during storage, handling, and reaction, and there is also some presence of CTC as an impurity in the finished product; these factors cause CTC 'consumption'. The various stages of the manufacturing process include feedstock preparation, chlorination, recovery of solvent, filtration, drying, blending and packing. They require media resistant equipment (glass-lined reactors, lead bonded carbon steel reactors, etc.) The facilities have utility sections, comprising boilers for steam generation, refrigeration systems, diesel-based generating power sets for standby power generation, air compressors, cooling towers, etc. Finally, the facilities also have primary and secondary effluent treatment systems for waste water treatment and solid-waste disposal.

The details of CR production and CTC consumption for the last three years of production are as follows:

Table II: Average production and CTC consumption.

Year	CTC Consumed (MT)	CR Produced (MT.)
98-99	346	686
99-00	352	496
00-01	130	338
Average	276	507

The average consumption of CTC for the last three years of operation as mentioned above, is 276 MT per annum, which is 544 kg per MT of CR.

4. OPTIONS UNDER DECISION X/14

For ODS free CR production, the following options are available under decision X/14, and the costs of the various options are assessed in the following discussion:

1. Total closure
2. ODS emission abatement
3. Conversion to non-ODS process

The first two options have already been discussed in details in the main document. This annex will focus on costing of Option 3.

4.1. OPTION 3: CONVERSION OF PRODUCTION FACILITY AT ANKLESHWAR.

The Executive Committee approved ROL Project for conversion to non ODS process for manufacturing of Chlorinated Rubber at its 34th Meeting. The ROL Project has installed capacity of 550 MT and was granted with an incremental cost of US\$ 2.07 million after deduction of US\$ 330,537 on account of provision of a new plant. Rishiroop Rubber International (RRIL) is proposing to use the same technology for converting its full capacity of 4,500 MT of chlorinated rubber per year. The detailed conversion process is described below.

5. Project Proposal:

Several modifications /additions are required for converting the existing plant equipment to the new process. These include installation of new process equipment, storage facilities, piping and infrastructure facilities (e.g. power, water, air), etc., with different construction materials to match the new process conditions.

A list of the equipments required to be added/replaced to replace the existing capacity of CR at Ankleshwar is given at **Annex 1**.

A brief description of the major additions in equipment required is given below:

- 60 KL capacity fiber-glass reinforced polyester (FRP) storage tanks to store both fresh and recovered acid.
- Storage tank of 30 KL capacity of Stainless Steel to store rubber latex as a new raw material.
- Glass-lined carbon steel reactors of 8 kl capacity for preconditioning prior to chlorination.
- Glass-lined carbon steel reactors of capacity of 8 kl to carry out the new chlorination process. The existing glass-lined reactors are unsuitable. The new process requires a different type of agitation system in the reactor, which does not exist in the existing reactors and has to have modification in the nozzles of the reactor to accommodate the photochemical lamps.
- A Photochemical system will be added to catalyze the reaction.
- Pumps of corrosion resistant material for various operations such as circulating the contents of the reactor during chlorination and transporting the chlorinated product.
- Glass-lined stirred tanks of 8 kl capacity to store the reaction product after the chlorination process.
- Replacement corrosion resistant filters to remove the acid from the reaction product. The material of the present filtration equipment does not render it suitable for use.
- The filtered reaction product must be conveyed to the dryer by a conveying system along with a storage bin and a feeder. At present, this is handled by a screw conveyor, which will be unsuitable since the CR from the conventional process has different flow characteristics.
- Spray dryers will be required to remove the moisture from the wet product. The existing spin flash dryers are not suitable for this purpose.
- A pneumatic conveying system to convey the chlorinated rubber powder obtained from the dryer to a blending and packing unit.

- The fume extraction system will consist of suction ducting, suction blower, lime absorption column and lime circulation pumps which will absorb any trace hazardous gases emanating in the new process from various reactors and storage tanks. Further, in order to remove final traces of acid and chlorine from the tail gases, it would be necessary to scrub these gases with dilute alkali in a column prior to final discharge to atmosphere.
- The acid absorption system of higher capacity will consist of an acid scrubber, corrosion resistant pumps and an acid storage tank and acid absorber.
- An enhanced effluent treatment facility will be installed consisting of neutralizer settling tank, aerators and sludge pumps to handle a larger quantity of waste water. This facility will treat the trace quantities of acid and chlorine gas and bring it within standard norms required by the local pollution control authorities.
- A major portion of the existing piping and valves has to be replaced due to new process conditions and acidic material. Most of the new piping will be of PVDF or stainless steel or Teflon-lined carbon steel.
- Additional safety equipment to supplement existing equipment will be procured. This will consist of hazardous gases leakage detection, sensing, alarm and control system.

5.1. Civil Works and Utilities

The existing civil structures at RRIL, Ankleshwar are expected to be inadequate for accommodating the equipment for the converted production facility. Additional structural facilities will be required to accommodate the additional reactors and other process equipment. Some changes will also be necessary to be incorporated to the existing civil and structural facilities..

- Additional civil works will have to be incurred for construction of new tank farms for acid and rubber latex storage, acid-proof tile lining in critical process areas, additional underground water storage tank, civil foundations for various new equipment, additional storage facility for finished goods, etc.
- The new process does not require use of steam, thus rendering the existing steam boilers redundant. The converted plant will, however, require a much larger quantity of water requiring additional water storage and handling facilities. Consequently the size of effluent treatment facility will be bigger.
- Sizable additional connected power requirements will primarily arise due to the photochemical system in the new process. This will include an increase in electrical load transformer capacity with attendant transmission connection charges and enhanced main power distribution center, etc. In addition, the standby diesel generation capacity will need to be suitably augmented so as to ensure continuous power supply during the critical reaction process.
- A higher capacity cooling system such as chilling plants will have to be installed to cater to the augmented capacity and the requirements of the new process.
- To meet additional requirements of air for process and instrumentation, compressors will have to be installed in combination with suitable air dryers.

5.2. Redundant Equipment

The equipment becoming redundant or to be replaced in this project is given in **Annex 3**. The used equipment is generally more than 8 years old and has low book value. Having been used in chemical process plants, the equipment has virtually no salvage or resale value,.

6. JUSTIFICATION FOR THE SELECTION OF ALTERNATIVE TECHNOLOGY

Three alternative technologies exist for conversion to ODS free production of CR, as follows:

1. A solvent exchange process developed and patented by a German company.
2. A non-ODS process developed by a Japanese company.
3. A non-ODS developed indigenously in India by RRIL.

Solvent Exchange Process : A German enterprise has adopted a two stage procedure to reduce the emissions from their process and to eliminate the CTC contained as impurity in the CR produced by them as under:

- a) The German enterprise spent about US\$25 million to reduce the emissions in their **7,000 TPA capacity** plant from a level of about 430 MT in 1989 to a level of about 0.3 MT in 1996 and that too over a period of 7 years of intensive efforts.
- b) In addition, this enterprise has spent about US\$40 million to modify its plant to reduce the impurity of CTC from its product, which was eventually being emitted to the atmosphere in the end use. This was done by adopting a patented process for the solvent exchange by it.
- c) Furthermore, the German enterprise has stated that they are incurring an incremental operating cost for environmental operation of their plant of US\$0.8 million per year

These details are consistent with the description on chlorinated rubber applications provided in the Report of the Chemical Process Agents Working Group of the TEAP, May 1995 . It seems to be clear that this alternative is expensive and has other limitations as it presents an interim solution and an eventual conversion to a non ODS process will be later required to be carried out.

Non-ODS Japanese process: A Japanese enterprise has developed a non-ODS process for CR and commercialized it in 1997. According to some news reports the Japanese process cost the company an investment of about Yen 1 billion to set up a production facility of 800 MT of CR per annum, which is expensive and not very cost effective, (a brief write up on this subject from Japan Chemical Weekly (J.C.W. April 20, 1995 is available in the project file in the Bank. RRIL had contacted this Japanese company, but an agreement for licensing their patent did not materialize.

Non-ODS RRIL process : The new RRIL process of chlorination of rubber through aqueous media completely eliminates the usage of CTC, and the CR produced by this process does not contain any entrapped CTC. **RRIL applied for a domestic patent for their process in December 1998, and have registered a provisional patent under Indian law on January 8, 1999.** By changing over to technology, RRIL will achieve complete elimination of CTC usage in their integrated converted facility at Ankleshwar.

PROJECT COST:

The incremental capital cost includes major components as follow:

Process Equipment	\$ 8,830,530
Effluent Treatment Facility	\$ 300,000
Process Utility and Piping	\$ 1,195,000
Electrical Equipment	\$ 280,000
Instrumentation, Dismantling and Erection Costs, Insulation & Painting, Safety Equipment, Civil and Structural Work, Consultant's fees for detailed Engineering	\$ 1,800,000
Know-how development	\$ 344,000
Trial and Training	\$ 300,000
Change-over Costs	\$ 460,000
Start-up and Commissioning	\$ 600,000
Sub-total	\$14,109,530
Contingencies (10%)*	\$ 1,376,553
Total	\$15,486,083

*Contingency of 10% does not apply to the cost of know-how development.

Details of the incremental capital costs are given in **Annex 1**.

The incremental operating costs are expected to be US\$ 161,829 for one years operation based on 507 TPA production level as given in **Annex 2**.

Thus the total incremental project cost is expected to be about US\$ 15,647,912.

7. PROJECT IMPLEMENTATION

The Project will be implemented by M/s RRIL in Ankleshwar. The proposed implementation schedule illustrated below becomes effective after the OTF grant is made available. The change over from the existing plant will entail a production shutdown of about 12 months.

IMPLEMENTATION SCHEDULE

	QUARTERS											
	Year 2002				Year 2003				Year 2004			
	1	2	3	4	1	2	3	4	1	2	3	4
MF Project Approval	X											
Financial Appraisal		X										
Sub grant Agreement		X										
Equipment specification preparation		X	X									
Equipment procurement			X	X								
Installation of equipment				X	X							
Civil work			X	X	X							
Testing and trials						X	X					
Production Start-up							X	X				
Project completed									X			
First Disbursement		X										
Final Disbursement									X			
Completion Report.									X			

Direct Benefits:

During the first 12 months of operation of the converted plants, the quantity of ODS phased out will total 276 MT of Carbon tetrachloride (304 ODP Tons)

Indirect Benefits:

There are no indirect benefits from this project.

ANNEX 1

I NCREMENTAL CAPITAL COST FOR 4500 TPA PLANT AT RRIL				
Sr.No.	Item	Unit Cost (USD)	Nos.	Total (USD)
A PROCESS FACILITY				
1	FRP storage tanks (50kl)	16500	4	66,000
2	PVDF lined magnetic sealless pump	3300	6	19,800
3	Stainless steel storage tank 30 kl	27500	2	55,000
4	Air operated PTFE-lined diaphragm pump	10670	5	53,350
5	Stainless steel blending reactor(1kl)	11000	4	44,000
6	Air operated PTFE-lined diaphragm pump	6600	16	105,600
7	Glass-lined Carbon Steel Reactors(8kl)	66000	8	528,000
8	Glass-lined Carbon Steel Reactors(8kl)	98000	16	1,568,000
9	PVDF Lined Carbon Steel housing in photo-chemical system	3300	32	105,600
10	Photochemical System	25,300	32	809,600
10.1	Spare equipment for photochemical system start up	88000	1	88,000
	Cooling system photo chemical systems exchanger (2.5 m2)			
11.1	Stainless steel heat exchanger (2.5 m2)	770	32	24,640
11.1	Stainless steel centrifugal pump (1m3/hr)	770	32	24,640
12	Static Mixer	4400	16	70,400
13	Graphite heat exchanger (10 m2)	15400	16	246,400
14	PVDF/PTFE AOD pumps.	13200	32	422,400
15	Glass-lined Stirred tanks (8 kl)	66000	10	660,000
15a	Air Operated PVDF-lined diaphragm pump	10450	4	41,800
15b	PVDF Surge Suppressor	3850	4	15,400
16	FRP belt filter system (350 kg/hr)	495000	2	990,000
17	Wet product conveying system	88000	2	176,000
18	Stainless steel feed bins(15kl)	38500	2	77,000
19	PTFE-LINED stainless steel dryer system consisting of hot oil generator, radiator, air filter, dust collector, blower etc.	495000	2	990,000
20	PVDF lined magnetic pump, 2m ³ /hr, 20 mH	4400	4	17,600
21	Piping – PVDF, Stainless steel, FRP, PP, CPVC, ABS pipes, valves and fittings.	440000	1	440,000
22	Pneumatic conveying system	440000	1	440,000
23	Stainless steel 316 Feed bins (30 KL)	30250	2	60,500
24	UPS system for photochemical system	15400	32	492,800
25	Stainless steel blender (5 kl)	27500	2	55,000

26	FRP Fume Extraction system with alkali scrubber	143000	1	143,000
	Sub-total group A			8,830,530
B	EFFLUENT TREATMENT FACILITY			
1	Reinforced concrete tank – Neutralizer	40000	2	80,000
2	Reinforced concrete settling tank	20000	2	40,000
3	Reinforced concrete tank –Aerator	20000	2	40,000
4	Sludge Pumps	1000	10	10,000
5	Acid proof lined reinforced concrete sludge drying beds	20000	3	60,000
6	Effluent Tank	30000	2	60,000
7	Consultant's fees for designing ETP system	10000	1	10,000
	sub-total group B			300,000
	C PROCESS UTILITY & PIPINGS (Annex 9)			
	Utility			
1	Air dryers 40 m ³ /min	45000	2	90,000
2	Air Compressors 40 m ³ /min	75000	2	150,000
3	Cooling Tower(1500 TR)	35000	1	35,000
4	Underground water storage tank	25000	1	25,000
5	Overhead Tank	10000	1	10,000
6	Chilling plants (150 TR)	125000	2	250,000
8	Diesel Generators 1700 KVA	225000	2	450,000
9	Water softeners	20000	2	40,000
10	Air Receiver	25000	1	25,000
11	Mild steel/ABS pipes, valves & fittings for above	120000	1	120,000
	Sub-total group C			1,195,000
	D ELECTRICALS			
1	Transformer	50000	1	50,000
2	Additional Powerline cost	40000	1	40,000
3	Power Control Centre	60000	1	60,000
4	Capacitors	30000	1	30,000
5	Electrical Cables, switches, starters etc.	100000	1	100,000
	Sub-total group D			280,000
	E INSTRUMENTATION	250000	1	250,000
	Control panels, Instruments such as rotameters, pressure gauges, temp gauges, Control valves, Misc. items (cables, etc) and labor charges			

F	DISMANTLING OF SURPLUS ITEMS	150000	1	150,000
G	ERECTION COSTS	250000		250,000
H	INSULATION & PAINTING	150000	1	150,000
I	SAFETY EQUIPMENTS	100000	1	100,000
	Continuous chlorine monitoring system			
	HCL monitoring system			
J	CIVIL WORKS	250000	1	250,000
	Consists of equipment foundations, tank farms, acid-proof tile lining, civil costs of power control centers, process control rooms and warehouse expansion and architects fees.			
J	STRUCTURAL WORK	400000	1	400,000
K	KNOW HOW DEVELOPMENT COST	344000	0	344,000
L	Consultant's fees for detailed engineering @ 2.5%	250000	1	250,000
	Total (E to L)			2,144,000
M	Pre- operative Cost Trial, Training and commissioning.			
	Insurance			
	Traveling			
	Training			
	Salaries of project team			
	Communication expenses			
	sub-total group M			300,000
N	Changeover costs			460,000
	Fixed Overhead cost for twelve months			
O	Start up & commissioning			600,000
	Cost of materials and variable costs			
	Commissioning			
	TOTAL			14,109,530
	Contingencies @10%*			1,376,553
	TOTAL INCREMENTAL INVESTMENT COST			15,486,083

*Contingency does not apply to know-how development.

ANNEX 1.1
JUSTIFICATION FOR INVESTMENT COST FOR CONVERSION PROJECT OF 4500 TPA

	NEW EQUIPMENT	CAPACITY	UNITS	JUSTIFICATION/APPLICATION
	A. PROCESS FACILITY			
1	Fiber reinforced polyester (FRP) storage tanks (new)	50 kl	4	Required for storing fresh HCL as well as recovered HCL
2	Polyvinylidene fluoride resin (PVDF) lined magnetic sealless pumps (new)		6	Required for transfer of HCL at various stages
3	Stainless Steel (SS) 316 Storage Tank (new)	30 kl	1	Required for rubber latex storage
4	Air operated diaphragm pump (new)		5	Required for transfer of latex from storage tank to latex blending vessel.
5	SS 316 Blending Reactor (new)	1 kl	4	Required to blend latex with additives.
6	Air operated Diaphragm Pump (new)		16	Required for transfer of process fluid from blending reactor to hold tank.
7	Glass-lined Carbon Steel Reactor (replacement)	8 kl	8	Required to precondition the feedstock for chlorination.
8	Glass-lined Carbon Steel (replacement)	8 kl	16	Required for chlorination
9	PVDF lined Carbon Steel housing for photochemical system (new)		32	Required to encase the photochemical system.
10	Photochemical system (new)		32	Required for the reaction
11	Cooling System consisting of 11.1 and 11.2 (new)			
11	SS 316 Heat Exchanger (new)	2.5 m2	32	Cooling equipment for photochemical system
11	SS 316 Centrifugal Pump (new)		32	Cooling equipment for photochemical system
12	Static mixture (new) (FRP)		16	Required to introduce the chlorine gas in the process solution
13	Graphite Heat Exchangers	10 m2	16	Required to remove the heat of reaction
14	PVDF/PTFE AOD Pumps		32	Required for circulation of HCL + Latex slurry in photochemical system loop.
15	Glass-lined Carbon Steel reactor	8 kl	10	Required for hold up of the product prior to filtration
15a	Air operated PVDF lined diaphragm pump with surge impressors.		4	Required for slurry circulation
16	Filter system (replacement)	350 kg/hr	2	Required to separate the reaction product from HCL
17	Filtered reaction product conveying system (new)		2	Required to transfer the filtered product to the dryer feed bins
18	SS 316 Feed bins	15 kl	2	Required for feeding the wet product to the dryer
19	Dryer system consisting of hot oil thermic fluid generator, radiator dryer, bag filter, blower etc (new)		2	Required for drying of the wet CR
20	PVDF-lined magnetic pump		4	Required fro acid circulation
21	Corrosion resistant piping, valves and			Required for interconnecting the various equipment

	fittings (new) (PVDF/CPVC/ABS/PTFE)			in the process.
22	Pneumatic conveying system (new)		1	Required to transfer the dried product from the dryer to the hold bin for blending/packing
23	SS 316 feed bins	30 kl	2	Required to hold the dried product for blending/packing
24	Uninterrupted Power Supply	50 KVA	32	To protect the photochemical system from breakdown
25	SS 316 Ribbon Blender	5 kl	2	For dry blending of the product
26	FRP flume extraction systems (new)		1	Required to absorb any fumes of HCL or chlorine exhausted from various process equipment from the plant area.

ANNEX 2

INCREMENTAL OPERATING COSTS WITH NON ODS RRIL CR PROCESS

Figures in USD

Item of operating cost	Incremental cost per MR/CR	Incremental cost for 507 MT of CR*
Power	271.67	137,737
Fuel (Annex 3.1)	(43.23)	(21,918)
Materials (Annex 3.2)	69.97	35,475
Effluent Treatment (Annex 3.3)	20.78	10,535
TOTAL (USD)	319.19	161,829

*Average production level for the last three years.

ANNEX 2.1

INCREMENTAL OPERATING COST

FUEL CONSUMPTION COST

CURRENT CTC PROCESS

1. Quantity of furnace oil consumed / MT CR = 1100 liters.
2. Out of which, approximate quantity consumed in various processes is as under:
 - a) Dissolver : 110 liters
 - b) Precipitator : 330 liters
 - c) Dryer : 660 liters

TOTAL : 1100 liters

NEW PROCESS

1. There will be no requirement of steam in dissolution or precipitation processes. So there will be net savings of 440 liters of furnace oil in the new process.
2. There will be a change in the drying process and furnace oil will be required to heat the air but no steam generation will be required. However, due to higher heat losses through hot air, there will be an overall increase in energy requirements for the new drying process by about 10 % over the old drying process. So the furnace oil requirements for drying in the new process will be about 770 liters / MT of CR.

Net savings of furnace oil/MR CR = $1100 - 770 = 330$ liters

Net incremental cost of furnace oil consumed per Mt CR = $330 \times \text{USD } 0.31/\text{liter}$
= (**USD 43.23/MT**)

Net incremental cost of furnace oil for 507 MT /year = USD 21,918

ANNEX 2.2

INCREMENTAL OPERATING COSTS

MATERIALS CONSUMPTION COSTS

A. REQUIREMENTS OF RAW MATERIALS FOR NON ODS PROCESS

NAME OF RAW MATERIAL	QTY. (KG./MT OF CR)	UNIT RATE (USD/KG.)	COST (USD/MT CR)
1. LATEX 60 %	635.0	0.762	483.87
2. LIQUID CHLORINE	1200	0.107	128.40
3. CAUSTIC LYE 50 %	450	0.143	64.35
4. STABILIZERS	40	1.571	62.84
5. SURFACTANT	25	2.619	65.48
		TOTAL	804.94

B. REQUIREMENTS OF RAW MATERIALS WITH CTC PROCESS

NAME OF RAW MATERIAL	QTY. (KG./MT OF CR)	UNIT RATE (USD/KG.)	COST (USD/MT CR)
1. SYNTHETIC RUBBER	380	1.048	398.24
2. LIQUID CHLORINE	1200	0.107	128.40
3. CTC	544	0.3	189.3
4. STABILIZERS	10	1.571	15.71
5. CATALYST 1	1.38	2.976	4.11
6. CATALYST 2	0.43	8.69	3.74
		TOTAL	739.49

Net incremental cost of raw materials/MT of CR (B-A) = USD 69.97

Net incremental cost of raw materials for 507 MT /year = USD 35,475

ANNEX 2.3

INCREMENTAL OPERATING COST

EFFLUENT TREATMENT COST

A. UNDER EXISTING PROCESS

MATERIAL	QTY REQUIRED KG/ MT OF CR	UNIT RATE (USD/KG.)	COST (USD/KG.)
LIME	275	0.071	19.52

B. UNDER NEW NON ODS PROCESS

MATERIAL	QTY REQUIRED KG/ MT OF CR	UNIT RATE (USD/KG.)	COST (USD/KG.)
LIME	400	0.071	28.40
OTHER CHEMICALS	-	-	11.90
		TOTAL	40.30

Incremental effluent treatment cost per MT of CR produced = USD 20.78

Hence, incremental effluent treatment cost for 507 MT of CR produced per year = USD 10,535.

ANNEX - 3		
LIST OF REDUNDENT EQUIPMENTS		
Sr No.	Equipments	No.
1	Rubber Crusher	1
2	Lead bonded jacketted steel reactor (10KL)	3
3	S.S. Pump(10m ³ /hr, 20mH)	2
4	Glasslined Carbon Steel reactor (8KL)	8
5	S.S. Centrifugal Pump (10m ³ /hr, 20mH)	4
6	Hatelloy C CentrifugalPump (3m ³ /hr, 30mh)	2
7	Hastelloy C Stirred reactors (6KL)	3
8	Glass fibre reinforced polyester tanks (10KL)	3
9	S.S. Centrifugal slurry pump (10m ³ /hr, 25mH)	2
10	S.S. Centrifugal pump (10m ³ /hr, 10mH)	2
11	Agitated Nutsche filter (6 KL)	2
12	Vacuum Pump	2
13	S.S. Screw Conveyor	2
14	S.S. feed bin (10 KL)	3
15	Spin flash dryer	2
16	Spin flash dryer	2
17	Pneumatic conveying system	1
18	Pulveriser	1
19	S.S. Ribbon blender(2 KL)	1
20	PVDF lined magnetic sealless pumps (2m ³ /hr)	4
21	Exhaust blowers	2
22	Air compressors	3
23	GRP cooling tower (100TR)	1
24	Chilling plant 25 TR	2
25	Water softner	1
26	Boilers	2
27	HCL storage pump	2
28	Caustic Pumps	2
29	CTC pump	2

RISHIROOP RUBBER WORLD BANK (REVISED).doc / 30/8/2001

**37th MEETING OF THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR
THE IMPLEMENTATION OF THE MONTREAL PROTOCOL**

Annex VI Part B

COUNTRY:	India
IMPLEMENTING AGENCY:	World Bank
PROJECT TITLE:	Conversion of Chlorinated Rubber manufacture from Carbon Tetra Chloride to non-ODS process at Rishiroop Polymers Pvt. Ltd. India
PROJECT IN CURRENT BUSINESS PLAN:	Yes
SECTOR:	Solvents
SUB-SECTOR:	Process agents
ODS USE IN SECTOR:	Baseline (1999-2001) 304 ODP tons Current (1997) 7876 ODP tons (total CTC consumption as reported to the MP ozone secretariat).
PROJECT IMPACT (ODS TO BE ELIMINATED):	Phase out 225 MT CTC (248 ODP tons)
PROJECT DURATION:	24 months
PROJECT COSTS:	
Investment Capital Costs	US\$ 2,396,588
Contingencies (10%)	US\$ 215,859
Incremental Operating Costs (NPV for 1 year)	US\$ 0
Total Project Cost	US\$ 2,612,447
LOCAL OWNERSHIP:	100%
EXPORT COMPONENT:	
REQUESTED GRANT:	Part of Sector Plan
IA SUPPORT COST:	Part of Sector Plan
TOTAL COST TO MLF:	Part of Sector Plan
COST EFFECTIVENESS:	Part of Sector Plan
PROJECT MONITORING MILESTONES INCLUDED:	Yes
NATIONAL COORDINATING AGENCY	MoEF, National Ozone Unit

PROJECT SUMMARY

This project will lead to elimination of the use of 225 MT per year (248 MT ODP) of Carbon Tetra Chloride in the manufacture of Chlorinated Rubber by Rishiroop Polymers Pvt. Ltd. (RPL). The proposed proprietary technology to be adopted has been developed indigenously by an associated enterprise, Rishiroop Rubber (International) Ltd. using a non-ODS media for the chlorination reaction, and is non-transitional.

Prepared by: Indian Chemical Manufacturers Association and the World Bank
OORG review by: William Kenyon

Date: March 21, 2002
Date: April 22, 2002

1. PROJECT OBJECTIVEES

The objective of this project is to completely eliminate the use of Carbon Tetra Chloride (CTC) as a process solvent in the production of Chlorinated Rubber (CR) by Rishiroop Polymers Pvt. Ltd. (RPL) at their plant at Nasik, India.

The implementation of this project will contribute to helping India to meet its obligations to phase out use of Ozone Depleting Substances (ODS).

2. SECTOR BACKGROUND

The detailed information on the process agent sector is included in the main document.

3. DESCRIPTION OF PRODUCTION FACILITIES

RPL is a 100% Indian owned private limited company, and was incorporated in 1971, with a production facility at Nasik (Maharashtra state), mainly for the manufacture of CR, and also for a small quantity of aromatic resin. The production facility started commercial production in 1973, with an initial installed production capacity for CR of 150 MT per annum; the plant was debottlenecked and expanded in 1988 to increase the installed production capacity to the current level of 550 MT per annum calculated on a three shift basis (continuous production), to meet growing market demand. The maximum production of CR attained by RPL was 532 MT in the fiscal year 1990-91. RPL is a pioneer in developing the indigenous technology for manufacture of CR in India, and have received a national Government award in 1978 for import substitution for developing the process for CR indigenously.

Production at RPL was suspended in September 1995 because of a labor dispute, which was referred to an Industrial Court. It was resolved in October 1999, and RPL has serviced its plant and kept it ready to restart production at short notice.

RPL uses CTC as an inert solvent in the manufacture of CR. The conventional process for production of CR involves using CTC as a solvent medium for chlorination of the rubber. The dry rubber is first dissolved in CTC, and this rubber solution is reacted with chlorine gas to produce chlorinated rubber which stays dissolved in CTC. The solvent CTC is then recovered from this CR solution by flashing it in hot water and recycling it. Because CTC is required to be used as a process solvent and is handled in large quantities, the process causes emissive losses during storage, handling, and reaction, and there is also some presence of CTC as an impurity in the finished product; these factors cause CTC 'consumption'. The various stages of the manufacturing process include feedstock preparation, chlorination, recovery of solvent, filtration, drying, blending and packing. They require media resistant equipment (glass-lined reactors, lead bonded carbon steel reactors, etc.) The facility has utility sections, comprising boilers for steam generation, refrigeration systems, diesel-based generating power sets for standby power generation, air compressors, cooling towers, etc. Finally, the facility also has primary and secondary effluent treatment systems for waste water treatment and solid waste disposal. A detailed description of the conventional CR process is at **Annex 1**.

The details of CR production and CTC consumption for RPL for the last three years of production are as follows:

Table I: Average Production and CTC Consumption

RPL		
Year*	CTC consumed (MT)	CR Produced (MT)
92-93	222.	376.
93-94	219.	365.
94-95	235.	372
Average	225	371.

*: The production and consumption data for RPL are for 3 years prior to Sept. 95 when the industrial lock-out began.

The total average consumption of CTC for RPL, based on their average consumption for the last three years of operation as mentioned above, is 225 MT per annum.

4. OPTIONS UNDER DECISION X/14

For ODS free CR production, the following options are available under decision X/14, and the costs of the various options are assessed in the following discussion:

1. Total closure
2. ODS emission abatement
3. Conversion to non-ODS process

The first two options have already been discussed in details in the main document. This annex will focus on costing of Option 3.

4.1. OPTION 3: CONVERSION OF PRODUCTION FACILITY

The Executive Committee approved ROL Project for conversion to non ODS process for manufacturing of Chlorinated Rubber at its 34th Meeting. The ROL Project has installed capacity of 550 MT and was granted with an incremental cost of US\$ 2.07 million after deduction of US\$ 330,537 on account of provision of a new plant. Rishiroop Polymers (RPL) is proposing to use the same technology for converting its full capacity of 550 MT of chlorinated rubber per year. The detailed conversion process is described below. Details of these costs are at Annex 2.

5. Project Proposal:

Several modifications /additions are required for converting the existing plant equipment to the new process. These include installation of new process equipment, storage facilities, piping and infrastructure facilities (e.g. power, water, air), etc., with different construction material to match the new process conditions.

A list of the equipments required to be added/replaced to replace the existing capacity of CR at RPL is given at Annex 2.

A brief description of the major additions in equipment required is given below:

- 15 KL capacity fiber glass reinforced polyester (FRP) storage tanks to store both fresh and recovered acid.
- Storage tank of 15 KL capacity of Stainless Steel to store rubber latex as a new raw material.
- Glass-lined carbon steel reactors of 8 kl capacity for preconditioning prior to chlorination.
- Glass-lined carbon steel reactors of capacity of 8 kl to carry out the new chlorination process. The existing glass-lined reactors have smaller capacity and are unsuitable. The alternative option of using a larger number of smaller existing reactors will require use of more procurement of more expensive imported additional equipment for each reactor. In addition, the new process requires a different type of agitation system in the reactor which does not exist in the existing reactors.
- A Photo chemical system will be added to catalyze the reaction.
- Pumps of corrosion resistant material for various operations such as circulating the contents of the reactor during chlorination and transporting the chlorinated product.
- Glass-lined stirred tanks of 8 kl capacity to store the reaction product after the chlorination process.
- Replacement corrosion resistant filters to remove the acid from the reaction product. The material of the present filtration equipment does not render it suitable for use.

- The filtered reaction product must be conveyed to the dryer by a conveying system along with a storage bin and a feeder. At present this is handled manually since the CR from the conventional process has different flow characteristics.
- Fluidized bed dryers will be required to remove the moisture from the wet product. The existing rotary vacuum dryers are not suitable for this purpose.
- a pneumatic conveying system to convey the chlorinated rubber powder obtained from the dryer to a blending and packing unit.
- The fume extraction system will consist of suction ducting, suction blower, lime absorption column and lime circulation pumps which will absorb any trace hazardous gases emanating in the new process from various reactors and storage tanks. Further, in order to remove final traces of acid and chlorine from the tail gases, it would be necessary to scrub these gases with dilute alkali in a column prior to final discharge to atmosphere.
- The acid absorption system of higher capacity will consist of an acid scrubber, corrosion resistant pumps and an acid storage tank and acid absorber.
- An enhanced effluent treatment facility will be installed consisting of neutralizer settling tank, aerators and sludge pumps to handle larger quantity of waste water. This facility will treat the trace quantities of acid and chlorine gas and bring it within standard norms required by the local pollution control authorities.
- A major portion of the existing piping and valves have to be replaced due to new process conditions and acidic material. Most of the new piping will be of either stainless steel or Teflon-lined carbon steel.
- Additional safety equipment to supplement existing equipment will be procured. This will consist of hazardous gases leakage detection, sensing, alarm and control system.

5.1. Civil Works and Utilities

With some extensions and modifications, the existing civil structures at RPL, Nasik are expected to be adequate for accommodating the equipment for the converted aggregate production facility. Some changes will however be necessary.

- Additional civil works will have to be incurred for construction of new tank farms for acid and rubber latex storage, acid-proof tile lining in critical process areas, additional underground water storage tank, civil foundations for various new equipment, additional storage facility for finished goods, etc.
- The new process does not require use of steam, thus rendering the existing steam boilers redundant. The converted plant will, however, require a much larger quantity of water requiring additional water storage and handling facilities. Consequently the size of effluent treatment facility will be bigger.
- Sizable additional connected power requirements will primarily arise due to the photochemical system in the new process. This will include an increase in electrical load transformer capacity with attendant transmission connection charges and enhanced main power distribution center, etc. In addition, the standby diesel generation capacity will need to be suitably augmented so as to ensure continuous power supply during the critical reaction process.
- A higher capacity cooling system such as chilling plants will have to be installed to cater to the augmented capacity and the requirements of the new process.
- To meet additional requirements of air for process and instrumentation, compressors will have to be installed in combination with suitable air dryers.

5.2. Redundant Equipment

The equipment becoming redundant or to be replaced in this project for RPL is given in **Annex 3**. The used equipment is generally more than 8 years old and has low book value. Having been used in chemical process plants, the equipment has virtually no salvage or resale value.

6. JUSTIFICATION FOR THE SELECTION OF ALTERNATIVE TECHNOLOGY

Three alternative technologies exist for conversion to ODS free production of CR, as follows:

1. A solvent exchange process developed and patented by a German company.

2. A non-ODS process developed by a Japanese company.
3. A non-ODS developed indigenously in India by RRIL.

Solvent Exchange Process : A German enterprise has adopted a two stage procedure to reduce the emissions from their process and to eliminate the CTC contained as impurity in the CR produced by them as under:

- a) The German enterprise spent about US\$25 million to reduce the emissions in their **7,000 TPA capacity** plant from a level of about 430 MT in 1989 to a level of about 0.3 MT in 1996 and that too over a period of 7 years of intensive efforts.
- b) In addition, this enterprise has spent about US\$40 million to modify its plant to reduce the impurity of CTC from its product which was eventually being emitted to the atmosphere in the end use. This was done by adopting a patented process for the solvent exchange by it.
- c) Furthermore, the German enterprise has stated that they are incurring an incremental operating cost for environmental operation of their plant of US\$0.8 million per year

These details are consistent with the description on chlorinated rubber applications provided in the Report of the Chemical Process Agents Working Group of the TEAP, May 1995 (Annex 6). It seems to be clear that this alternative is expensive and has other limitations as it presents an interim solution and an eventual conversion to a non ODS process will be later required to be carried out.

Non-ODS Japanese process: A Japanese enterprise has developed a non-ODS process for CR and commercialized it in 1997. According to some news reports the Japanese process cost the company an investment of about Yen 1 billion to set up a production facility of 800 MT of CR per annum, which is expensive and not very cost effective, (a brief write up on this subject from Japan Chemical Weekly (J.C.W. April 20, 1995 is available in the project file in the Bank. RRIL has been in contact with this Japanese company, but an agreement for licensing their patent did not materialize, due to licensing of the process, cost of technology transfer, availability of the license without any operational restrictions, etc., which made it practically inaccessible to RRIL.

3. Non-ODS RRIL process : The new RRIL process of chlorination of rubber through aqueous media completely eliminates the usage of CTC, and the CR produced by this process does not contain any entrapped CTC. The new process will be licensed from RRIL, who have developed it through their in-house research. RRIL applied for a domestic patent for their process in December 1998, and have registered a provisional patent under Indian law on January 8, 1999; they expect to be able to complete the patent process by April 2003, by which time they also expect to be able to receive an international patent for the process. RPL will achieve in complete elimination of CTC usage in its converted facility at Nasik

PROJECT COST:

The incremental capital cost includes major components as follow:

Process Equipment	\$ 1,409,100
Effluent Treatment Facility	\$ 59,400
Process Utility and Piping	\$ 214,288
Electrical Equipment	\$ 60,500
Instrumentation, Dismantling and Erection Costs, Insultation & Painting, Safety Equipment, Civil and Structural Work	\$ 175,000
Consultant's fees for detailed Engineering	\$ 60,000
Know-how development	\$ 238,000
Trial and Training	\$ 108,800
Change-over Costs	\$ 0
Start-up and Commissioning	\$ 71,500

Sub-total	\$ 2,396,588
Contingencies (10%)*	\$ 215,859
Total	\$ 2,612,447

*Contingency of 10% does not apply to the cost of know-how development.

Details of the incremental capital costs are given in **Annex 2**.

No provision for incremental operating costs is made for RPL as there has been no production for the last three years.

Thus the total incremental project cost is expected to be about US\$ 2,612,447.

7. PROJECT IMPLEMENTATION

The Project will be implemented by M/s RPL in Nasik with the technical assistance and know how from M/s Rishiroop Rubber (International) Ltd.. The proposed implementation schedule illustrated below becomes effective after the OTF grant is made available. The change over from the existing plant will entail a production shutdown of about 6 months.

IMPLEMENTATION SCHEDULE

Activity	Quarters											
	Year 2003				Year 2004				Year 2005			
	1	2	3	4	1	2	3	4	1	2	3	4
MF Project Approval			X									
Financial Appraisal				X	X							
Sub grant Agreement				X	X							
Equipment specification preparation					X							
Equipment procurement						X	X					
Installation of equipment							X	X				
Civil work					X	X	X					
Testing and trials								X	X	X		
Production Start-up										X	X	
Project completed							X	X			X	
First Disbursement					X							
Final Disbursement												X
Completion Report.												X

Direct Benefits:

During the first 12 months of operation of the converted plants, the quantity of ODS phased out will total 225 MT of Carbon tetrachloride (248 ODP Tons).

Indirect Benefits:

There are no indirect benefits from this project.

CONVENTIONAL CTC-BASED CR MANUFACTURING PROCESS

Natural/Synthetic Rubber is first mechanically degraded on a two roll mill and then charged to a depolymerising reactor where it is mixed with a large quantity of CTC and subjected to further depolymerising by chemical and thermal means. The resultant depolymerised hydrocarbon becomes completely dissolved in CTC and is used as a feed-stock solution for the chlorination process.

The rubber solution is thereafter subjected to reaction with chlorine gas in the glass-lined reactors to produce chlorinated rubber, at which time HCL gas is produced as a by-product, and is carried away in the off gas from the reactors. Each of the chlorination reactors is equipped with a series of graphite condensers where the vapors emanating from the reactors are first cooled with cooling water and thereafter with chilled brine solution circulating at minus15 degrees Celsius. This results in the condensation and recycling of the CTC vapors going off from the chlorination reactors with the off gas. The off gases escaping from the condensers are introduced into a primary effluent treatment system for scrubbing down the HCL gas and converting it into 30% w/w hydrochloric acid. The tail gas from the HCL scrubbers is further subjected to treatment in lime towers to neutralize it with lime solution followed by scrubbing with caustic soda solution.

The chlorinated rubber thus formed remains dissolved in the CTC and this solution is subjected to purging with air/nitrogen to remove the residual entrapped HCL /chlorine in the solution. The CR solution is then transferred to hold tanks from where it is drawn into lead bonded reactors equipped with a series of graphite heat exchangers. In these reactors, the CTC is flashed by pumping the CR solution under hot water and CTC is thus condensed and sent back to process CTC storage tanks for recycling back to the rubber dissolution stage. During the process of CTC recovery, CR is formed as a particulate slurry in water. The product is recovered as a granular wet cake containing about 60% moisture by separating it from the CR slurry in nutsch filters / centrifuges.

The wet cake of CR is then charged to a series of rotary vacuum driers from where the product is obtained as a dried powder containing less than 0.2% moisture content. The dried CR powder is discharged into bins and thereafter taken up for sieving and blending for meeting the grade wise quality requirements. The product is thereafter packed and shipped out.

**INCREMENTAL COSTS SUMMARY FOR PLANT CONVERSION
RPL,NASIK**

This annex provides a summary of Incremental Costs (US\$) of converting the RPL plant at Nasik to non-ODS manufacture.

Details are provided in the tables that follow.

Capital Costs:	\$2,612,447
Operating Costs:	\$ 0
Total for one plant:	\$2,612,447

Annex Table 2A: INCREMENTAL CAPITAL COSTS

Sl.	ITEM	UNIT COST	Units	Total
A. PROCESS FACILITY				
	1 FRP Storage Tank 15KL	3,850	4	15,400
	2 PVDF Lined magnetic seal-less Pump	3,300	6	19,800
	3 Stainless Steel Storage Tank	17,050	1	17,050
	4 Air operated PTFE – lined diaphragm pump	6,600	5	33,000
	5 Stainless Steel Blending Reactor 1KL	7,920	1	7,920
	6 Air operated PTFE – lined diaphragm pump	6,600	2	13,200
	7 Glass lined Carbon Steel Reactor	66,000	1	66,000
	8 Glass lined Carbon Steel Reactor	107,800	2	215,600
	9 PVDF Lined Carbon Steel Housing for photo chemical systems	3,300	4	13,200
	10 U. V. Lamp Systems	25,300	4	101,200
	11 Cooling Systems for photo chemical systems			
	11 Stainless Steel Heat Exchange	770	4	3,080
	11 Stainless Steel Centrifugal Pump	770	4	3,080
	12 Static Mixer	4,400	2	8,800
	13 Graphite heat exchanger (10m ²)	15,400	2	30,800
	14 PVDF lined magnetic seals pump	6,270	7	43,890
	15 Glass-lined Stirred Tanks	66,000	1	66,000
	16 FRP belt filter (100 kg/hr)	203,500	1	203,500
	17 Paste Conveying systems	31,900	1	31,900
	18 Stainless Steel 316 Feed Bins (10KL)	8,800	2	17,600
	19 Two stage PTFE lined SS316 Fluidized bed dryer system	183,700	1	183,700
	20 PVDF FRP Tanks, 10KL	23,100	2	46,200
	21 PVDF lined magnetic Pump 2m ³ /hr, 20MH (heads in meters)	2,200	2	4,400
	22 Piping, PVDF, SS, FRP, PP Pipes valves and fittings	66,000	1	66,000
	23 Pneumatic conveying system	74,800	1	74,800

24	Stainless Steel 316 Feed bins(10KL)	8,800	2	17,600
25	UPS Systems for photo chemical systems	15,400	4	61,600
26	Stainless Steel Blenders 2KL	16,500	1	16,500
27	Chimney for Exhaust gases	5,280	1	5,280
28	FRP fume extraction systems with alkali scrubber	22,000	1	22,000
Sub-total				1,409,100
B EFFLUENT TREATMENT FACILITY				
1	Reinforced concrete tank – Neutralizer	6,600	2	13,200
2	Reinforced concrete settling Tank	3,300	2	6,600
3	Reinforced concrete Tank – Aerator	8,800	1	8,800
4	Sludge Pumps	330	10	3,300
5	Acid proof lined Reinforced concrete Sludge Drying Beds	2,200	2	4,400
6	Acid proof lined Reinforced concrete Sludge Storage with shed	4,400	1	4,400
7	RCC treated Effluent Storage tank	6,600	2	13,200
8	RCC Flocculator	3,300	1	3,300
9	Consultant fees for designing ETP system	2,200	1	2,200
Sub-total				59,400
C PROCESS UTILITY PIPING				
Utility				
1	Air Dryers 8m3/min	11,000	2	22,000
2	Air Compressor 8m3/min	22,000	2	44,000
3	Underground Water storage	5,500	1	5,500
4	Overhead Water tank	3,850	1	3,850
5	Chilling plant	17,600	2	35,200
6	Diesel generators	68,537.7	1	68,537.7
7	Water softeners	5,500	2	11,000
8	Air Receiver	7,700	1	7,700
9	Mild Steel pipes valves & fittings for above	16,500	1	16,500
Sub-total				214,287.7
D ELECTRICAL				
1	Transformer	8,800	1	8,800

	2 Power line cost	8,800	1	8,800	
	3 Power Control Center	16,500	1	16,500	
	4 Capacitors	4,400	1	4,400	
	5 Electrical Cables, switches starters etc.	22,000	1	22,000	
	Sub-total				60,500
E	INSTRUMENTATION		Unit	80,000	80,000
	Control panels, instruments (including rota-meters, pressure gauges, temperature gauges, control valves) misc. items, and labor charges				0
					0
F	ERECTION & DISMANTLING		Unit	20,000	20,000
					0
G	INSULATION & PAINTING		Unit	20,000	20,000
					0
H	SAFETY EQUIPMENTS		Unit	20,000	20,000
	Continuous chlorine and HCL monitoring systems				0
					0
I	CIVIL WORKS		Unit	15,000	15,000
	Equipment Foundations, tank farms, acid-proof tile lining, and civil costs of power control center, process control room and expansion of warehouse, architect's fee				0
					0
J	STRUCTURAL WORK		Unit	20,000	20,000
					0
K	TECHNICAL KNOW HOW FEE		Unit	238,000	238,000
					0
L	Consultants fees for detailed engineering		Unit	60,000	60,000
M	Pre operative Cost		Unit		
	Insurance			20,000	
	Travelling			28,800	
	Training			12,000	
	Salaries of project team			38,800	
	Communication expenses			9,600	
	Sub-total				108,800
N	Changeover costs (fixed overheads for six months)		Unit	0	0
O	Start up & commissioning (incl. Materials costs)		Unit	71,500	71,500

	TOTAL				2,396,588
	Contingencies				215,859
	TOTAL INCREMENTAL INVESTMENT COST (US\$)				2,612,447

Annex Table 2B: INCREMENTAL OPERATING COSTS

Item	Unit	Before Conversion (US\$, per MT of CR produced)			After Conversion (US\$, per MT of CR produced)			Net Incremental Cost (US\$/yr.)
		Qty	Rate	Amount	Qty	Rate	Amount	
Power	KWH	3,158	0.107	337.906	5,697	0.107	609.579	271.673
Furnace oil	Liters	1,100	0.131	144.1	770	0.131	100.87	-43.23
Materials ¹	Kg	various		739.49	various		804.94	69.97
Consumable Stores ²					Various		0	0
Effluent Treatment								
Lime	Kg.	275	0.071	19.525	400	0.071	28.40	8.875
Other chemicals	Kg.						11.90	11.90
Total IOC /MT of CR produced								319.19
Total C.R. Production,								0
Total incremental operating costs/year								0
Incremental operating costs (NPV for ONE year)								0

¹ Before: Synthetic rubber /Polyolefin, liquid chlorine, CTC, stabilizers, and three catalysts.
After: Latex, liquid chlorine, Caustic lye, stabilizers and additives.

² Photochemical System, pumps for transfer of reaction products, and air-operated diaphragm pumps. Per MT costs derived from calculations at \$117,000 for 550 TPA

REDUNDANT EQUIPMENT LIST

Sr. No.	Item	Nos
1	Rubber Mixing Mill	1
2	Acid proof brick lined tank (10KL)	2
3	Graphite tile lined steel tank (10KL)	2
4	Lead bonded carbon steel tanks (10kl)	2
5	Pumps	
	a) Silica Epoxy centrifugal Pump (2m3/Hr, 20mH)	1
	b) Silica Epoxy centrifugal Pump (10m3/Hr, 20mH)	4
	c) S. S. centrifugal Pump (10m3/Hr, 20mH)	2
	d) S. S. centrifugal Pump (2m3/Hr, 10mH)	2
	e) S. S. centrifugal Pump (5m3/Hr, 10mH)	2
	f) Cast S. sludge Pump (5m3/Hr, 10mH)	2
6	Glasslined Carbon steel Reactor (5kl)	2
7	Glasslined Carbon steel Reactor (4kl)	0
8	Glasslined Carbon steel Reactor (3kl)	0
9	Lead bonded Carbon Steel Reactors (10KL)	4
10	Glass fiber carbon steel stirred vessel 10KL)	1
11	Graphite Heat Exchanger (5m2)	12
12	Rotary Vacuum S316 dryers (2m3 cap)	4
13	Nutsch Filter (15KL)	2
14	Oil fired steam boilers	2
15	Centrifuges	0
16	Brine chilling plants (10 TR)	2
17	Air compressors (3m3/min)	2
18	Diesel generator (250 KVA)	1
19	Horizontal Glass fiber reinforced polyster tanks (5KL)	3
20	Graphite acid absorption system (60kg/hr)	1
21	Water softeners (5m3.Hr)	1
22	Carbon steel vertical storage tanks (10KL)	1
23	Air receivers (3m3)	1
24	Transformer (500 KVA)	1

OORG TECHNICAL REVIEW REQUEST
India

**Sector Plan for Phasing Out of CTC Consumption in the
Chlorinated Rubber Sub-Sector in India**

(OORG Reviewer: W. G. Kenyon)

OORG TECHNICAL REVIEW REQUEST

China

Sector Plan for Phasing Out of CTC Consumption in the Chlorinated Rubber Sub-Sector in India

(OORG Reviewer: W. G. Kenyon)

The following review of the "Sector Plan for Phasing Out of CTC Consumption in the Chlorinated Rubber Sub-Sector in India" (received 21 March 2002) was conducted at the request of the World Bank.

1. **Country of Origin:** India
2. **Project Title:** " Sector Plan for Phasing Out of CTC Consumption in the Chlorinated Rubber Sub-Sector in India"
3. **Sector/Subsector Covered:** Solvents/Process Agents
4. **Relationship to Country Programme:** Project documentation provided indicates that while not required to meet the 1999 freeze for CTC, and is thus consistent with the country's action plan.

5. **Technology:**

- a) The CTC in use in the Process Agents subsector is generally used as a solvent for the chemical processes used in the manufacture of chlorinated rubber, chlorinated paraffin, various other halogenated resins and polymers plus a variety of pharmaceuticals and agricultural products.

There are three options permitted under decision X/14. These are:

- a. Total Closure
- b. ODS Emission Abatement
- c. Conversion to a non-ODS Process.

(In addition, various combinations of these options are generally allowed)

Alternatives for ODS CTC are often difficult to identify. Thus, while alternatives are generally readily available in other sectors, this is not the case when the CTC is an integral part of the manufacturing process. In some cases, it may not be possible to totally eliminate the CTC, but instead the sub-sector may have to consider other pathways for ozone layer protection, such

as stringent emission abatement, plant closures or implementing CTC alternatives. In some nations, several of these options are combined.

In general, the non-ODS processes tend to be aqueous or proprietary, which would tend to preserve the manufacture of materials and products of value to society.

The phase out alternatives of either stringent emission abatement or plant closure are generally used only when a non-ODS alternative cannot be identified. In some cases, a cluster of enterprises making like product may elect to rationalize production to facilitate production yield and purity optimization; with several enterprises serving their established customer base from a common manufacturing operation.

In addition, workplace time-weighted averages (TWA), if any, for the proposed aqueous or other types of formulations may not be regulated in all provinces in India.

- b) Enterprises prefer to choose a technology that is not currently transitional, since it does not depend upon a solvent or chemicals that, at this time, face future bans. In addition, the technology chosen must balance product quality vs cost of alternative process or technology implementation.

In this sector plan, the enterprises involved using CTC to manufacture chlorinated rubber (CR) have selected a combination of conversion to an indigenous proprietary CR manufacturing process, while two enterprises will undergo plant closure (rationalization).

- c) Feasibility of transfer to the country of concern:
 - i) Technology transfer and training are not applicable, since the technology was developed by one of the Rishiroop Group enterprises. This technology has already been approved for one partner enterprise (ROL Chlorinated Rubber (CR) project at the 34th Meeting of the ExCom), and this sector plan proposes the same process be implemented at two others.
 - ii) There appears to be no licensing agreement required since the technology was developed in India by the enterprise.
 - iii) Other options (plant closure or continued use of CTC combined with stringent emission control) were investigated but discarded in favour of the new proprietary technology for certain plants and full closure for two other enterprises.

Other technology systems utilizing ozone safe chemistries may have been investigated but discarded when CR product quality was inferior to

the current ODS process. The enterprises did not want to continue use of CTC (combined with stringent emission abatement), even in low concentrations in the CR, as it could prove to be a disadvantage in the marketplace, resulting in loss of market share. GWP issues due to increased energy costs were checked but no comprehensive calculations were performed.

iv) See paragraphs 5 b, 5 c ii and 5 c iii above.

6. Environmental Impact:

- a) The ODP is zero for the proprietary process chosen. However, there is an increase in the furnace oil and electrical power requirements, resulting in a modest indirect GWP increase. However, with the closure of two other CR producing enterprises, efficient overall operation of the remaining CR producers may result in minimal GWP impact.
- b) The proposed proprietary process provides adequate safety from an environmental, safety and health perspective- within the limits of any process employing liquid chlorine. (The workforce has had experience handling liquid chlorine with the present process; so periodic refresher training combined with vigilance should minimize any workplace hazards.) Appropriate waste stream protection systems are incorporated in the various pieces of equipment to minimize contamination of the aquifers.
- c) The proposed various aqueous cleaning systems provide adequate safety from an environmental, safety and health perspective. Appropriate filtration and waste water systems are incorporated in the various pieces of equipment to minimize contamination of the aquifers. Special case will be required in the case of stringent emission abatement systems, since the possibility of aquifer contamination is still possible, albeit to a lesser degree.
- d) It is often very difficult to assess the waste stream increase generated by alternative processes. Such increases can be the result of making large volumes of sub-standard product, increased HCl waste, waste activated carbon or other emission control media. (For example, certain of the alternatives will involve use of stringent emission controls employing activated carbon to recover CTC. In such cases, it would be preferable to incinerate the activated carbon and any remaining CTC, since steam stripping the activated carbon could provide a pathway for CTC to enter the groundwater.

7. Project Cost:

- a) All the cost components identified in the project are essential to the conversion. The proposed equipment should provide an up to date, efficient,

zero-ODP CR manufacturing process incorporating proper waste stream management with capacity levels equivalent to current production levels.

- b) Existing equipment similar to the proposed new equipment would be expected to be found in the existing facilities, since both the old and new processes involve the chlorination of rubber to make CR. However, the scale of the equipment and the capacity of the pumps (for example) will quite different, as larger equipment is needed to handle dilute solutions or slurries, compared with concentrated solutions or slurries. (This is a materials handling and not a capacity issue.)
- c) Cost of equipment
 - i) The base line costs are properly addressed. The suggested equipment costs appear consistent with current industry pricing practices.
 - ii) The proposed equipment and technology listed is claimed to be readily available from local suppliers. All requested equipment is consistent with the project plan. (see also 7. b)
 - iii) It appears that the various pieces of equipment requested should meet the conversion requirements for replacing CTC with the proprietary new non-ODS CR manufacturing processes requested. (There is a possibility that water pre-treatment systems not cited in the document for treating and upgrading any incoming water may be required. If this is the case, the costs shall be borne by the enterprise.)
 - iv) The existing baseline CTC process equipment in this enterprise cannot be modified/converted for use in the new process, due to issues of scale.
 - v) While dismantling of baseline equipment was noted as a line item in the budgets, especially for the two plants being closed, a detailed plan for the scrapping out and disposition of the current baseline solvent equipment to prevent re-deployment is not provided. [See however, 7. c) vi) below.]
 - vi) Projected salvage value of the ca 8 yr old scrapped equipment was given as low book value. Also, the scrapped equipment has virtually no value since it was used in a chemical process plant. (Project commissioning personnel should carefully monitor final destruction and disposition of all the surplus/scrapped equipment from all the enterprises listed in this sector plan.)
 - vii) The proposed project equipment and quantity listed for the proprietary process gave no obvious indication there would be an increase in existing capacity.

- d) Appropriateness of training and related costs, if any:

The individual project budgets contain line items for training with the new equipment, as well as commissioning. Since the enterprise will be converting from CTC to an entirely new proprietary process, these costs are warranted.

- e) Operating Costs

- i) The Incremental Operating Costs (IOC) projected after the conversion are much higher than the existing costs. The increased costs appear to be associated with the additional utilities (especially heating oil), raw materials and effluent treatment chemicals. Increased energy consumption is to be expected with the utilization of new processes involving heating and transfer of dilute solutions.
- ii) The new process and equipment, while minimizing environmental, health and safety impacts associated with the new chemistry are projected to result in increased operating costs due to higher raw materials cost, higher effluent treatment costs and additional energy consumption. No reduction in defects that could translate into cost savings is apparent.
- iii) The operating costs given and their relation to the technology chosen appear to be consistent with projects already approved by ExCom for implementation (e.g. ROL, approved at 34th meeting).

8. Implementation Time Frame: The implementation time frame proposed appears feasible however since this is a new proprietary process installation, it may be too aggressive.

9. Recommendation:

- a) **Approval is endorsed.**

10. Special Concerns: Due to the proprietary process information contained in this project proposal, the review of this project was carried out only by the World Bank and OORG review personnel.



OORG Technical Reviewer: _____
W. G. Kenyon

Date Review Completed: 23 April 2002

OORG TECHNICAL REVIEW REQUEST
India

**Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride
to non-ODS process at Rishiroop Polymers Pvt. Ltd. India**

(OORG Reviewer: W. G. Kenyon)

OORG TECHNICAL REVIEW REQUEST

India

Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Polymers Pvt. Ltd. India

(OORG Reviewer: W. G. Kenyon)

The following review of the "Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Polymers Pvt. Ltd. India" (received 16 April 1999) was conducted at the request of Mr. Viraj Vithoontien, World Bank.

1. **Country of Origin:** India
2. **Project Title:** "Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Polymers Pvt. Ltd. India"
3. **Sector/Subsector Covered:** Solvents/Process Agents
4. **Relationship to Country Programme:** Project documentation provided indicates that while not required to meet the 1999 freeze, project is consistent with the country's action plan.
5. **Technology:**
 - a) There are three options permitted under decision X/14. These are:
 - a. Total Closure
 - b. ODS Emission Abatement
 - c. Conversion to a non-ODS Process.

The enterprise has elected to pursue Conversion to a non-ODS Process, as was chosen by the ROL Chlorinated Rubber (CR) project at the 34th Meeting of the ExCom. This new proprietary process was developed by an associated enterprise in the Rishiroop group, namely Rishiroop Rubber International Ltd. India.

Since the alternative non-ODS process requires significant volumes of heated water, and greater utility demands, a GWP greater than the present CTC process would be anticipated.

In addition, time-weighted averages (TWA), if any, for the proposed new proprietary process are not known. Thus, not all the chemicals in this process may be regulated in India.

- b) The proprietary technology chosen is not currently transitional since it does not appear to depend upon chemicals that, at this time, face future bans.
- c) Feasibility of transfer to the country of concern:
 - i) Technology transfer and training are not applicable, since the technology was developed within the enterprise.
 - ii) There appears to be no licensing agreement required since the technology was developed in India by the enterprise.
 - iii) Other options (plant closure or continued use of CTC combined with stringent emission control) were investigated but discarded in favour of the new proprietary technology. The enterprise did not want to continue use of CTC, even in low concentrations in the CR, as it could prove to be a disadvantage in the marketplace, resulting in loss of market share.
 - iv) Yes, see paragraphs 5 b, 5 c ii and 5 c iii above.

6. Environmental Impact:

- a) The ODP is zero for the proprietary process chosen. However, there is an increase in the furnace oil and electrical power requirements, resulting in a modest indirect GWP increase.
- b) The proposed proprietary process provides adequate safety from an environmental, safety and health perspective- within the limits of any process employing liquid chlorine. (The workforce has had experience handling liquid chlorine with the present process; so periodic refresher training combined with vigilance should minimize any workplace hazards.) Appropriate waste stream protection systems are incorporated in the various pieces of equipment to minimize contamination of the aquifers.

7. Project Cost:

- a) All the cost components identified in the project are essential to the conversion. The proposed equipment should provide an up to date, efficient, zero-ODP CR manufacturing process incorporating proper waste stream management with capacity levels equivalent to current production levels.
- b) Existing equipment similar to the proposed new equipment would be expected to be found in the existing facilities, since both the old and new

processes involve the chlorination of rubber to make CR. However, the scale of the equipment and the capacity of the pumps (for example) will quite different, as larger equipment is needed to handle dilute solutions or slurries, compared with concentrated solutions or slurries. (This is a materials handling and not a capacity issue.)

c) Cost of equipment

- i) The base line costs are properly addressed. The suggested equipment costs appear consistent with current industry pricing practices.
- ii) The proposed equipment and technology listed is claimed to be readily available from local suppliers. All requested equipment is consistent with the project plan. (see also 7. b)
- iii) It appears that the various pieces of equipment requested should meet the conversion requirements for replacing CTC with the proprietary new non-ODS CR manufacturing processes requested. (There is a possibility that water pre-treatment systems not cited in the document for treating and upgrading any incoming water may be required. If this is the case, the costs shall be borne by the enterprise.)
- iv) The existing baseline CTC process equipment in this enterprise cannot be modified/converted for use in the new process, due to issues of scale.
- v) While dismantling of baseline equipment was noted as a line item in the budgets, a detailed plan for the scrapping out and disposition of the current baseline solvent equipment to prevent re-deployment is not provided. [See however, 7. c) vi) below.]
- vi) Projected salvage value of the ca 8 yr old scrapped equipment was given as low book value. Also, the scrapped equipment has virtually no value since it was used in a chemical process plant.
- vii) The proposed project equipment and quantity listed for the proprietary process gave no obvious indication there would be an increase in existing capacity.

d) Appropriateness of training and related costs, if any:

The individual project budgets contain line items for training with the new equipment, as well as commissioning. Since the enterprise will be converting from CTC to an entirely new proprietary process, these costs are warranted.

e) Operating Costs

- i) The Incremental Operating Costs (IOC) projected after the conversion are much higher than the existing costs. The increased costs appear to be associated with the additional utilities (especially heating oil), raw materials and effluent treatment chemicals. Increased energy consumption is to be expected with the utilization of new processes involving heating and transfer of dilute solutions.
- ii) The new process and equipment, while minimizing environmental, health and safety impacts associated with the new chemistry are projected to result in increased operating costs due to higher raw materials cost, higher effluent treatment costs and additional energy consumption. No reduction in defects that could translate into cost savings is apparent.
- iii) The operating costs given and their relation to the technology chosen appear to be consistent with projects already approved by ExCom for implementation (e.g. ROL, approved at 34th meeting).

8. Implementation Time Frame: The implementation time frame proposed appears feasible however since this is a new proprietary process installation, it may be too aggressive.

9. Recommendation:

- a) **Approval is endorsed.**

10. Special Concerns: Due to the proprietary process information contained in this project proposal, the review of this project was carried out only by the World Bank and OORG review personnel.



OORG Technical Reviewer: _____
W. G. Kenyon

Date Review Completed: 22 April 2002.

OORG TECHNICAL REVIEW REQUEST
India

**Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride
to non-ODS process at Rishiroop Rubber International Ltd. India**

(OORG Reviewer: W. G. Kenyon)

OORG TECHNICAL REVIEW REQUEST

India

Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Rubber International Ltd. India

(OORG Reviewer: W. G. Kenyon)

The following review of the "Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Rubber International Ltd. India" (received 16 April 1999) was conducted at the request of Mr. Viraj Vithoontien, World Bank.

1. **Country of Origin:** India
2. **Project Title:** "Conversion of Chlorinated Rubber Manufacture from Carbon Tetrachloride to non-ODS process at Rishiroop Rubber International Ltd. India"
3. **Sector/Subsector Covered:** Solvents/Process Agents
4. **Relationship to Country Programme:** Project documentation provided indicates that while not required to meet the 1999 freeze, project is consistent with the country's action plan.
5. **Technology:**
 - a) There are three options permitted under decision X/14. These are:
 - a. Total Closure
 - b. ODS Emission Abatement
 - c. Conversion to a non-ODS Process.

The enterprise has elected to pursue Conversion to a non-ODS Process, as was chosen by the ROL Chlorinated Rubber (CR) project at the 34th Meeting of the ExCom.

Since the alternative non-ODS process requires significant volumes of heated water, and greater utility demands, a GWP greater than the present CTC process would be anticipated.

In addition, time-weighted averages (TWA), if any, for the proposed new proprietary process are not know. Thus, not all the chemicals in this process may be regulated in India.

- b) The proprietary technology chosen is not currently transitional since it does not appear to depend upon chemicals that, at this time, face future bans.
- c) Feasibility of transfer to the country of concern:
 - i) Technology transfer and training are not applicable, since the technology was developed within the enterprise.
 - ii) There appears to be no licensing agreement required since the technology was developed in India by the enterprise.
 - iii) Other options (plant closure or continued use of CTC combined with stringent emission control) were investigated but discarded in favour of the new proprietary technology. The enterprise did not want to continue use of CTC, even in low concentrations in the CR, as it could prove to be a disadvantage in the marketplace, resulting in loss of market share.
 - iv) Yes, see paragraphs 5 b, 5 c ii and 5 c iii above.

6. Environmental Impact:

- a) The ODP is zero for the proprietary process chosen. However, there is an increase in the furnace oil and electrical power requirements, resulting in a modest indirect GWP increase.
- b) The proposed proprietary process provides adequate safety from an environmental, safety and health perspective- within the limits of any process employing liquid chlorine. (The workforce has had experience handling liquid chlorine with the present process; so periodic refresher training combined with vigilance should minimize any workplace hazards.) Appropriate waste stream protection systems are incorporated in the various pieces of equipment to minimize contamination of the aquifers.

7. Project Cost:

- a) All the cost components identified in the project are essential to the conversion. The proposed equipment should provide an up to date, efficient, zero-ODP CR manufacturing process incorporating proper waste stream management with capacity levels equivalent to current production levels.
- b) Existing equipment similar to the proposed new equipment would be expected to be found in the existing facilities, since both the old and new processes involve the chlorination of rubber to make CR. However, the scale of the equipment and the capacity of the pumps (for example) will quite different, as larger equipment is needed to handle dilute solutions or slurries,

compared with concentrated solutions or slurries. (This is a materials handling and not a capacity issue.)

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- i) The base line costs are properly addressed. The suggested equipment costs appear consistent with current industry pricing practices.
- ii) The proposed equipment and technology listed is claimed to be readily available from local suppliers. All requested equipment is consistent with the project plan. (see also 7. b)
- iii) It appears that the various pieces of equipment requested should meet the conversion requirements for replacing CTC with the proprietary new non-ODS CR manufacturing processes requested. (There is a possibility that water pre-treatment systems not cited in the document for treating and upgrading any incoming water may be required. If this is the case, the costs shall be borne by the enterprise.)
- iv) The existing baseline CTC process equipment in this enterprise cannot be modified/converted for use in the new process, due to issues of scale.
- v) While dismantling of baseline equipment was noted as a line item in the budgets, a detailed plan for the scrapping out and disposition of the current baseline solvent equipment to prevent re-deployment is not provided. [See however, 7. c) vi) below.]
- vi) Projected salvage value of the ca 8 yr old scrapped equipment was given as low book value. Also, the scrapped equipment has virtually no value since it was used in a chemical process plant.
- vii) The proposed project equipment and quantity listed for the proprietary process gave no obvious indication there would be an increase in existing capacity.

d) Appropriateness of training and related costs, if any:

The individual project budgets contain line items for training with the new equipment, as well as commissioning. Since the enterprise will be converting from CTC to an entirely new proprietary process, these costs are warranted.

e) Operating Costs

- i) The Incremental Operating Costs (IOC) projected after the conversion are much higher than the existing costs. The increased costs appear to be associated with the additional utilities (especially heating oil), raw

materials and effluent treatment chemicals. Increased energy consumption is to be expected with the utilization of new processes involving heating and transfer of dilute solutions.

- ii) The new process and equipment, while minimizing environmental, health and safety impacts associated with the new chemistry are projected to result in increased operating costs due to higher raw materials cost, higher effluent treatment costs and additional energy consumption. No reduction in defects that could translate into cost savings is apparent.
- iii) The operating costs given and their relation to the technology chosen appear to be consistent with projects already approved by ExCom for implementation (e.g. ROL, approved at 34th meeting).

8. Implementation Time Frame: The implementation time frame proposed appears feasible however since this is a new proprietary process installation, it may be too aggressive.

9. Recommendation:

a) **Approval is endorsed.**

10. Special Concerns: Due to the proprietary process information contained in this project proposal, the review of this project was carried out only by the World Bank and OORG review personnel.



OORG Technical Reviewer: _____
W. G. Kenyon

Date Review Completed: 22 April 2002.