UNITED NATIONS

EP

United Nations Environment Programme

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/63/15
11 March 2011

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Sixty-third Meeting
Montreal, 4-8 April 2011

REPORT ON IMPLEMENTATION OF APPROVED PROJECTS WITH SPECIFIC REPORTING REQUIREMENTS

Introduction

1. The Governments of Canada and Japan as well as UNDP, UNEP, UNIDO and the World Bank have submitted progress reports on the implementation of the following projects, where specific reporting requirements are contained in the respective agreements, for consideration by the Executive Committee at its 63rd Meeting:

(a) Brazil: National CFC phase-out plan: 2009 consumption verification and 2010 progress report (UNDP);

(b) China: Halon production and consumption phase-out programme: Investigation report for tail gas emission of halon-1301 in the production process of Fipronil (World Bank);

(c) China: Report on the conversion demonstration from HCFC-141b-based to cyclopentane-based pre-blended polyol in the manufacture of rigid polyurethane foam at Guangdong Wanhua Rongwei Polyurethane Co. Ltd (World Bank);

(d) China: Progress report on the implementation of the refrigeration servicing sector CFC phase-out plan (UNIDO);

(e) Costa Rica: Progress report on the implementation of the total methyl bromide phase-out used as a fumigant in melons, cut flowers, bananas, tobacco seedbeds and nurseries, excluding QPS applications (UNDP);

(f) Mexico: National methyl bromide phase-out plan (transfer of project) (UNIDO);

(g) Paraguay: Terminal phase-out management plan for Annex A Group I substances: 2008-2010 implementation report (UNEP); and

(h) Sri Lanka: National compliance action plan proposal for utilization of the remaining budget) (Japan).

2. The Secretariat reviewed the progress reports, request for project transfer and proposal for use of remaining budget, on the above listed projects in light of the original project proposals, ODS data reported by the Governments concerned under Article 7 of the Montreal Protocol, and relevant decisions taken by the Executive Committee and the Meeting of the Parties.

Brazil: National CFC phase-out plan: 2009 consumption verification and 2010 progress report (UNDP)

3. The national CFC phase-out plan (NPP) to completely phase out CFC consumption in Brazil by 1 January 2010 was approved by the Executive Committee at its 37th Meeting, at a level of funding approved in principle of US $26,700,000. The eighth and final tranche was approved by the Executive Committee at its 59th Meeting, with decision 59/40 requesting UNDP not to commence disbursement of the funding approved for the eighth tranche or any funding remaining after implementation of approved activities until the Committee had agreed, at a future meeting, an implementation plan covering activities related to the remaining funds. UNDP provided an implementation plan for the eighth tranche to the 60th Meeting, and the Executive Committee, through decision 60/8, noted the 2008 verification report and the 2009 annual implementation report on the NPP in Brazil, approved the annual implementation programmes for 2010 and 2011 and requested the Government of Brazil, with the assistance of UNDP, to submit annual implementation reports regarding the previous year to the first meeting of the Executive Committee each year until the NPP had been completed. UNDP submitted to the 63rd Meeting the

verification of consumption for the year 2009 and the 2010 progress report, as well as a 2011 annual implementation plan.

Progress report

4. The progress report provides information about the activities supporting Brazil in reducing its CFC consumption. While the Montreal Protocol phase-out schedule allows a consumption for 2009 of up to 1,578 ODP tonnes of CFCs, the agreement between the Government of Brazil and the Executive Committee restricts the CFC consumption in the country for 2009 to only 74 tonnes. UNDP has reported that the country had only consumed 46.9 ODP tonnes in 2009. The consumption figures for Brazil for 2010 were not included in the progress report.

5. The progress report provides details about a variety of activities undertaken in 2010. Three thousand CFC recovery sets for refrigeration technicians had been received, of which 150 had been distributed. A reclaim centre has been commissioned, but is not yet commercially operational due to a pending authorization from the local government. Four of the five planned storage centres for contaminated or impure CFCs have been established.

6. The progress report provided also data on the recovery and reclaimed amounts of CFC-12 and HCFC-22. In Brazil, amounts of recovered, recycled or reclaimed CFCs are reported in three distinct reporting systems: the CFC recovery activity for recycling centres, the reclaim centre activity, and the recovery and recycling (R&R) activities in mobile air conditioning (MAC).

(a) The data from the recovery activity directed at recycling centres shows that between 2006 and 2010 a total of 35.8 tonnes of CFC-12 and 62 tonnes of HCFC-22 have been recovered, of which 1.1 tonne of CFC-12 and 5.6 tonnes of HCFC-22 have been sent for reclamation. The numbers show a clear maximum in 2009; after 2009, the reporting requirements for the donated recovery units ceased, thus the data becomes unreliable and cannot be compared to previous years. The figures for 2009 show that in that year recovery of 27 tonnes of CFC-12 and more than 37 tonnes of HCFC-22 by technicians associated with the recycling centres;

(b) The reclaim centres have processed 47.8 tonnes of CFC-12 and 57.1 tonnes of HCFC-22. Since 2007, the amount of CFC-12 has constantly declined to a level of 4.8 tonnes in 2010, while the level of HCFC-22 seems to have increased, in 2010, to 16.9 tonnes of processed refrigerant;

(c) Results were also provided for the recovery and recycling (R&R) activities in mobile air conditioning (MAC), where in 335 units distributed in and before 2007, 16.5 tonnes of FC-12 were processed in that year. From 360 units distributed in and before 2008, 12.2 tonnes of CFC-12 had been processed in 2008, approximately the same number was processed in 2009 and possibly a higher number in 2010; the uncertainties of the numbers for 2009 and 2010 is related to the decreased reporting obligations under the conditions for equipment donations.

7. The 2010 action plan had foreseen retrofitting and/or exchange of up to three centrifugal chillers using CFCs owned by public agencies. Presently, identification of suitable buildings and hiring of a consultant is still ongoing. In other sectors, investment activities related to foam, solvents, sterilizers and commercial refrigeration had been concluded before 2010.

8. A number of non-investment activities were also undertaken during 2010. The activity regarding environmental management in the commercial refrigeration sector, addressing small and medium sized businesses that use CFC refrigeration equipment, is presently in the process of identifying a suitable

consultancy for the work. Under another activity, a technical workshop on "diffusion on the use of alternative fluids in refrigeration and air conditioning systems" has been held. Technical standards have been further developed and distributed, *inter alia*, relating to ammonia refrigeration, emission of refrigerants as well as to a procedure for recovery, recycling and reclamation. Some activities to strengthen the capacity to curb illegal trade in ODS have also been implemented. Finally, under the metered dose inhaler (MDI) transition strategy, a national workshop was held. An article related this symposium had been published and a documentary "transition from MDIs with CFCs to CFCs-free medication" to be used in training sessions of family health teams had been produced.

9. The verification report about the ODS consumption in Brazil in 2009 confirms the Article 7 consumption data provided by Brazil to the Ozone Secretariat by verifying a consumption of 46.86 ODP tonnes of CFCs for 2009. The verification report fulfilled the requirements and has demonstrated that Brazil has met the requirements of the agreement between the Government of Brazil and Executive Committee on CFC phase-out for 2009.

Annual implementation plan for 2011

10. For 2011, a number of activities need to be concluded in order to finalise the NPP. The annual implementation plan for 2011 foresees the distribution of 2,850 tool sets for refrigeration technicians, 500 recovery sets and 500 tool sets for recovery and reclaim centres. The organization of regional workshops for recovery, recycling and reclaim is also planned. One hundred twenty-five recycling centres are to be established within companies. For the R&R in the MAC sector, only the final evaluation in the sector is outstanding.

11. The replacement or retrofit of three centrifugal chillers, which originally were intended to be targeted earlier in the implementation is also planned for 2011. Four pilot activities for retrofits or replacements of small and medium size commercial refrigeration equipment are planned to establish demonstration material to educate owners and the public about the retrofit possibilities of such refrigeration systems. Finally, a second workshop on "diffusion on use of alternative fluids in refrigeration" will be held. The project will also continue to facilitate the establishment of suitable standards, as has been done in previous years. The federal technical registration for handling of ODS, including import, export and sales will be further enhanced. Finally, the documentation established regarding the transition from CFC-MDIs to alternative technologies will be widely distributed and a booklet will be published.

Secretariat's recommendation

12. The Secretariat recommends that the Executive Committee:

(a) Notes the 2009 verification report and the 2010 annual implementation report of the national CFC phase-out plan (NPP) in Brazil;

(b) Approves the annual implementation plan for 2011; and

(c) Requests the Government of Brazil with the assistance of UNDP as lead implementing agency, to continue submitting annual implementation reports regarding the previous year to the first meeting of the Executive Committee every year until the NPP is completed.

China: Halon production and consumption phase-out programme: Investigation report for tail gas emission of halon-1301 in the production process of Fipronil (World Bank)

13. In the context of the review of the technical audit with respect to tail gas emission of halon 1301 feedstock use in China, at its 59th Meeting, the Executive Committee, in decision 59/8(b)(iii), requested the Government of China and the World Bank:

> "a. To carry out, in an expeditious manner, a technical study to determine the level of halon 1301 emission through tail gas emissions resulting from the production of Friponil without incineration systems;
>
> b. To identify environmentally and economically sound measures to address such tail gas emissions;
>
> c. To report thereon to the Executive Committee at its 62nd Meeting."

14. The Government of the People's Republic of China, through the World Bank, has submitted an "Investigation Report for Tail Gas Emission of Halon 1301 in the Production Process of Friponil in China." The report is available upon request.

15. The report indicates that the domestic use of halon 1301 as a feedstock is growing. 2009 consumption was 491 metric tonnes. There are eight enterprises that use halon 1301 as a feedstock for Friponil production. The unit consumption of halon 1301 as a feedstock is much higher than the theoretical value. One of the eight enterprises uses an incineration unit in treating tail gas to eliminate halon 1301 emissions. Six of the remaining seven enterprises use technology 1, a gas-liquid-solid three-phase reaction system, while technologies 2 and 3 are gas-liquid two-phase reaction systems. One enterprise uses technology 2 and one enterprise uses technology 3. Unit consumption of halon 1301 in technology 1 varies from 1.03 to 1.32 tonnes per tonne of Friponil produced. One enterprise uses technology 2 and one enterprise switched from technology 1 to technology 3. Technologies 2 and 3 have unit consumptions of 0.57 tonnes per tonne of Friponil produced and 1.31 tonnes per tonne produced, respectively. The report indicates that there are 10 measures that could be taken to reduce unit consumption of halon 1301 relating to the following: the feeding process; the reaction process; post-treatment processes including buffer recovery and solvent absorption recovery systems; and recycling use. Measure 6, recommended for all enterprises that use technology 1, is to use compressors to evacuate halon 1301 from the top of the reactor to be pumped into a buffer tank for recycling. Three of the six enterprises that use technology 1 use this measure while three do not.

16. The following measures have already been taken in order to minimize losses of halon 1301:

> (a) Using magnetic stirring systems for the pressure reactor to avoid dynamic seal;
>
> (b) Both buffer tank and absorption tower are made of steel, using the technical standards of pressure vessels as design basis;
>
> (c) All the pipeline, valve, flange and instruments used are chosen following their technical specifications and the requirement of actual process conditions;
>
> (d) Facility layout is as compact as possible to decrease the length of pipelines and the number of flanges.

17. The annual emission levels of halon 1301 were 3.238 metric tonnes (32.4 ODP tonnes) in 2009 and 6.744 metric tonnes (67.4 ODP tonnes) in 2010 after the aforementioned measures had been taken.

The increase in emissions in 2010 was due to the change from technology 1 to technology 3 by one company.

18. The report recommends that the Government of China:

(a) Require that enterprises that adopt technology 1, should, if not already done so, implement the measure of evacuating halon 1301 from the top of the reactors with compressors to reduce the emission of halon 1301;

(b) Require that enterprises that adopt technologies 2 and 3 to make further process renovation and technical improvement to reduce halon 1301 emissions; and

(c) Provide quotas for procurements of halon 1301 only to enterprises meeting the above conditions.

Secretariat's comments

19. The issue of emissions of ODS when used as a feedstock was addressed at the Fourth Meeting of the Parties, at which the Parties decided *inter alia* "1. That insignificant quantities of controlled substances originating from inadvertent or coincidental production during a manufacturing process, from un-reacted feedstock, or from their use as process agents which are present in chemical substances as trace impurities, or that are emitted during product manufacture or handling, shall be considered not to be covered by the definition of a controlled substance contained in paragraph 4 of Article 1 of the Montreal Protocol; 2. To urge Parties to take steps to minimize emissions of such substances, including such steps as avoidance of the creation of such emissions, reduction of emissions using practicable control technologies or process changes, containment or destruction" (decision IV/12). The decision does not specify whether 67.4 ODP tonnes of halon 1301 emitted represents insignificant quantities of controlled substances from un-reacted feedstock.

20. In its report to the 59th Meeting, the Bank indicated that the cost of introducing emission reductions could be US $2 million per plant with 10 million RMB in annual operating costs. The plants without incineration systems have adopted other measures based on their expert advice in cooperation with industry. The Bank indicated that as this is a feedstock application and the companies are requested to implement the changes on their own, it has no information on the actual cost of the measures taken to reduce halon 1301 emissions.

21. The Bank also indicated that the Government may neither have the legal instrument nor the mandate to enforce recommendations from the auditors on this subject. The Bank clarified that the issues of the ODS regulations by the State Council of the People's Republic of China gives the federal environment ministry a stronger position for requiring control measures such as the ones required for halon 1301 used as feedstock. With this State Council ODS regulation, the federal environment ministry has a mandate to instruct provincial and local environmental protection bureaus (EPBs) to carry out enforcement and monitoring.

22. In the same report, the Bank also indicated that Friponil was toxic and there was a concern by the Government of China that the growing use of Friponil might lead to other environmental problems, such as water pollution. The Secretariat asked if the Government had taken any action in this regard. The Bank indicated that the Ministry of Agriculture responsible for regulating and approving pesticides has indeed put into place restrictions on the use of Friponil for applications where it could pose a risk for water pollution. However, there are still a number of applications allowed and the producers are expecting continued growth in the demand for and use of Friponil.

23. The Government has reviewed the report and has agreed to all the suggestions and recommendations in it.

24. With respect to the recommendation to implement measure 6 for those enterprises that have not yet done so, the Government has informed the companies that all the measures, including measure 6 should be implemented as soon as possible and no later than December 2011. The companies will report back to the federal environment ministry when all measures have been implemented and the federal environment ministry will, through on-site visits, confirm the implementation of the measures recommended in the report. If not implemented by the deadline, companies will not be able to obtain a halon 1301 procurement license for 2012.

25. With respect to the recommendation that enterprises that adopt technologies 2 and 3 should make further process renovation and technical improvement to reduce halon 1301 emissions, the federal environment ministry, through local EPBs, will monitor the progress of reducing the emission level. Issuance of halon 1301 procurement quotas for 2012 will be based on the emission reductions achieved by then.

Secretariat's recommendations

26. The Secretariat recommends that the Executive Committee request that the Government of China and the World Bank continue to report to the Fund Secretariat on the amount of halon 1301 emitted through tail gas emissions resulting from production of Friponil without incineration systems in future annual technical audit reports.

China: Report on conversion demonstration from HCFC-141b-based to cyclopentane-based pre-blended polyol in the manufacture of rigid polyurethane foam at Guangdong Wanhua Rongwei Polyurethane Co. Ltd. (World Bank)

27. On behalf of the Government of China, the World Bank has submitted to the 63rd Meeting of the Executive Committee a safety and technical feasibility analysis report on the project to demonstrate the conversion from HCFC-141-b-based to cyclopentane-based pre-blended polyol in the manufacture of rigid polyurethane foam at Guangdong Wanhua Rongwei Polyurethane Co. Ltd. This report is contained in Annex I to the present document.

Background

28. The project was approved at the 59th Meeting at a total cost of US $1,214,936, plus agency support costs of US $91,120 for the World Bank, on the understanding that the release of funding by the World Bank for stage II of the project, amounting to US $635,275, would be subject to successful validation of stage I and submission of the relevant report to the Fund Secretariat by the World Bank supporting the technical feasibility and safety of the full-scale demonstration project (decision 59/31(a)).

29. The objective of the project is to demonstrate the feasibility of pre-blending polyol with cyclopentane and the supply of the pre-blended polyol to foam producers and testing the approach in four foam producing enterprises. The first stage included installation of a 35 m^3 underground cyclopentane tank, two premixing machines, packaging system for steel drum packaging, buffer tanks and safety measures. The second stage included replacement of the foaming machines at the four enterprises with new ones and introducing safety measures. Operating costs were requested for one year.

Summary of safety and technical feasibility analysis report

30. The assessment of technical feasibility of the conversion to cyclopentane was considered particularly in terms of the key technical issue, i.e., the compatibility of cyclopentane with polyether. An

improved polyether structure and suitable foam stabilizer is required for a stable and homogeneous system. The stability of samples of 16 representative grades of dry pre-mixed formulated polyols from six manufacturers, including Wanhua Rongwei, were tested at temperatures ranging from -5°C to +25°C. The Jiangsu Research Institute of Product Quality Supervision and Inspection that carried out the stability tests found that the majority of the polyols tested have good stability and good compatibility with cyclopentane. These results indicated that the domestic polyether suppliers have solved the compatibility issue of cyclopentane and polyether.

31. Another critical component under the evaluation is the flammability of the mixture as it sets the requirements for transportation and requirements for storage and use within a company. Flash point tests were conducted to assess the safety hazard of the 16 samples of pre-mixed formulated polyols with cyclopentane and to classify them into a recognized hazard group. Tests carried out demonstrated that the formulated polyols categorized as class II flammable liquids. The formulated polyols with premixed cyclopentane can be transported over short and medium distances provided they meet the requirements of the specific transport regulations for dangerous goods.

32. Based on the assessment of the implementation of the Wanhua Rongwei conversion including its production method, adding further security features (a cyclopentane gas detection and monitoring system device and a water reservoir) was proposed. Once this additional equipment has been installed (scheduled for March 2011) Wanhua Rongwei will be in line with the relevant safety standards and codes.

33. Minea Electrical Appliance Co. Ltd, one of Wanhua Rongwei's four downstream enterprises, can be converted to meet the requirements of cyclopentane foaming by upgrading the production workshop to meet the fire-fighting bureau's requirements and improving the power supply to ensure safety detection equipment and exhaust ventilation will function in case of power outage. Since personnel have no experience with flammable substances, it is important that they be trained on safety issues and the correct handling of materials.

Secretariat's comments

34. The Secretariat raised several technical issues with the World Bank related to the need to demonstrate the stability of fully formulated hydrocarbon-based polyol systems over a 6-month period and the temperature range chosen for the stability tests, which does not fully represent the temperature range in China and in other countries given that the results of the demonstration project could be used in other Article 5 countries. The World Bank indicated that additional tests would be conducted to evaluate the impact of temperatures in the range up to 35°C during the subsequent stage of the project. There are no specific Chinese standards for testing stability of pre-blended polyols. However, the industry practice for the stability of any kind of mixed materials is normally six months. The University that conducted the previous tests has kept the samples at room temperature for six months. The stability has been validated.

35. It was also pointed out that the safety of using the fully formulated hydrocarbon-based polyol, that would be potentially supplied to downstream enterprises, should be assessed during transportation of the formulated polyols (from the systems houses to the foam enterprises) as well as under the prevailing conditions at the enterprise level, identifying the associated mitigating measures and their estimated associated costs. The World Bank responded that a number of accident situations had been evaluated taking into account potential by high ambient temperatures (i.e., accident during transportation and on-and off-loading; exposure of hydrocarbon drums to a fire in the foam workshop, leakage from a hydrocarbon drum during handling within the workshop, and hydrocarbon leakage from piping and foaming units). Safety guidelines had been developed accordingly. Cost calculations for safety measures would be reported as soon as the installation at the polyol supplier and the first downstream user are completed. The specific safety requirements for both the polyol supplier and the foam companies are set by the provincial fire fighting bureaus. As requirements given by the fire fighting bureaus are mandatory, the project will be implemented accordingly. Given that the cost is of greatest importance for the

downstream user (i.e., smaller foam companies), the follow-on report will provide the actual safety costs incurred. Stage I of the systems house demonstration project is planned to be completed by the end of May 2011 and the project report will be prepared in June 2011.

36. The Secretariat also sought a confirmation on whether or not, through the sampling of 16 grades of formulated polyols from six manufacturers, all technical issues related to the pre-blending of cyclopentane in polyols on industrial scale for distribution to and use by downstream foam producers will have been addressed. The World Bank responded that since the proportion of cyclopentane in pre-blended polyols is in a narrow range (10 to 12 per cent), 16 grades reflect a range of situations. It was not yet clear whether all technical issues have been addressed in regard to pre-blending on an industrial scale, however the major technical issues have been addressed indicating that industrial scale production and use of fully formulated hydrocarbon-based polyols is feasible. In response to the Secretariat's concerns that the report had not provided all the data needed to determine exactly how, at what cost and whether or not it is economically reasonable or feasible (both at the systems house and end-user levels) to develop and distribute fully formulated hydrocarbon-based polyols, the World Bank responded that it would submit the relevant reports when the total system, including production of pre-blended hydrocarbon polyols, delivery to companies and actual uses have been confirmed. The World Bank also indicated that the release of funding by it for Stage II of the project was subject to successful validation of Stage I and submission of the relevant report supporting the technical feasibility and safety of the full-scale demonstration project rather than the successful completion of Stage I. The report that has been submitted addressed the key activities to demonstrate successful validation (compatibility); shelf life; and, transport safety requirements). The World Bank further indicated that the report also provided safety plans for foam system houses and end-users in line with the Fire Fighting Standard in China. Based on these results, it concluded that this hydrocarbon pre-blended polyol option is technically feasible. The report confirms that existing regulations are adequate in addressing risks at various stages of supply chains and end-use. Therefore, the measure proposed by this report can ensure the same level of safety in dealing with hydrocarbons.

37. During the discussion of the project proposal at the 59th Meeting, the Secretariat raised an issue on the dissemination of the results of the demonstration project. The World Bank indicated that the foam industry has been kept fully informed of ongoing activities, the technical report has been discussed with the two other main systems houses in China that both consider pre-blended hydrocarbon polyol to be a viable option, and that two seminars have been organized to discuss the report with the industry.

Secretariat's recommendation

38. The Executive Committee may wish:

(a) To note the report on safety and technical feasibility analysis of the project to demonstrate the conversion from HCFC-141b-based to cyclopentane-based pre-blended polyols in the manufacture of rigid polyurethane foam at Guangdong Wanhua Rongwei Polyurethane Co. Ltd., submitted by the World Bank;

(b) To authorize the disbursement of US $635,275 by the World Bank to China for Stage II of the project;

(c) To request that the World Bank to submit the report for Stage I of the project including cost calculations for safety measures for consideration at the 65th Meeting of the Executive Committee.

China: Progress report on the implementation of the refrigeration servicing sector CFC phase-out plan (UNIDO)

39. On behalf of the Government of China, UNIDO, as the lead implementing agency, has submitted to the 63rd Meeting of the Executive Committee a progress report for the implementation of the "refrigeration servicing sector CFC phase-out plan for China" (service sector plan). UNIDO had submitted to the 62nd Meeting a verification for the sector consumption in the year 2009. The Executive Committee, in its decision 62/7, noted the verification report regarding the CFC consumption in the service sector in China in 2009 and also noted that the implementation report for 2009 and 2010 would be considered at the 63rd Meeting of the Executive Committee.

Background

40. The service sector plan was approved at the 44th Meeting of the Executive Committee, with UNIDO as lead agency and Japan as cooperating bilateral agency. The total funds approved in principle for the plan amounted to US $7,885,000 plus agency support costs of US $836,130. The agreement was amended at the 45th Meeting to also include UNEP as a cooperating implementing agency. The service sector plan is aimed at supporting China in meeting its Montreal Protocol obligations, including the complete phase-out of the controlled use of CFCs prior to 2010. In order to achieve these targets, a series of investment, non-investment technical assistance and capacity building activities have been implemented by China with the assistance of the agencies. The last tranche for this sector plan was approved at the 59th Meeting of the Executive Committee.

41. The verification presented to the 62nd Meeting verified a consumption of 398.56 ODP tonnes for the servicing sector, which is 7.4 ODP tonnes below the limit specified in the agreement between China and the Executive Committee for the 2009.

Annual implementation report for 2010

42. The activities performed in 2010 can be broadly associated with three different approaches to reduce and eliminate the dependence on CFCs. These areas are awareness activities, policy development and research studies as well as recovery and recycling (R&R) with a focus on end-of-life treatment of CFC-containing refrigeration and air conditioning equipment. The following provides a short summary of the results achieved:

(a) Technicians, enterprises and general public were addressed through publication material as well as regular reporting about the service sector plan in the China Ozone Action newsletter for stakeholders and technical personnel; in addition, promotion of CFC recovery, recycling and reclamation was undertaken on a national level to the general public;

(b) The policy activities undertaken by the Government include work on measures to facilitate the establishment of the CFC collection and reclamation system, as well as regulations to restrict CFC venting and CFC release in the process of refrigeration equipment service and of disposal of retired equipment;

(c) In the mobile air conditioning sector (MAC), the training of 6,067 technicians has been completed, and 410 MAC servicing stations and automobile disposing stations are undertaking the collection of MACs. Twenty-eight electric home appliance-dismantling stations were equipped with, in total, 200 sets of equipment to remove CFCs from retired appliances, with the personnel having received the necessary training. Eighty enterprises and training centres related to the service of industrial and commercial refrigeration equipment are in the process of receiving R&R equipment. China has also identified

50 ship dismantling stations, which do not have the technical capacity for ODS recovery. Currently preparations to provide the shipyards with recovery equipment are ongoing; and

(d) The activities in 2010 also included monitoring, verification and programme management as well as general oversight to ensure that the consumption limits of the servicing sector are being adhered to.

Annual implementation programme for 2011

43. The annual implementation programme for 2011 foresees the continuation and conclusion of the activities where progress had been reported in the 2010 implementation plan.

Secretariat's comments

44. The Secretariat noted the good progress of the implementation of the servicing sector plan and the relatively limited activities for 2011, which make project completion in 2011 likely. The Secretariat also noted the significant activities in collecting CFCs from equipment at the end of its life across various industry sectors, which in its broad approach is a unique feature in CFC phase-out plans.

Secretariat's recommendation

45. The Secretariat recommends that the Executive Committee:

(a) Takes note of the progress report on the implementation of the refrigeration servicing sector phase-out plan in China during 2010; and

(b) Approves the implementation programme for 2011, on the understanding that UNIDO will provide annually by calendar year, reports on the activities undertaken, the funds spent and budget remaining, until the financial closure of the phase-out plan.

Costa Rica: Progress report on the implementation of the total methyl bromide phase-out used as a fumigant in melons, cut flowers, bananas, tobacco seedbeds and nurseries, excluding QPS applications (UNDP)

Background

46. On behalf of the Government of Costa Rica, UNDP has submitted to the 63rd Meeting the 2010 annual progress report on the implementation of the fifth tranche of the project for the total phase-out of methyl bromide (MB) used as a fumigant in melons, cut flowers, bananas, tobacco seedbeds and nurseries, excluding QPS applications.

47. The project was approved in principle by the Executive Committee at its 35th Meeting, together with funding for the first tranche (US $1,211,321 plus agency support costs of US $143,245 for UNDP). The second and third tranches were approved at the 43rd Meeting and the fourth tranche at the 49th Meeting; the fifth tranche of the project was approved at the 59th Meeting at a total cost of US $726,791 plus agency support costs of US $54,509 for UNDP. The following disbursement schedule by UNDP was also agreed: US $363,400 in 2009; US $255,000 at the end of 2010; and US $108,391 at the end of 2012, on the understanding that disbursement of the funds for 2010 and 2012 would be subject to a report to be submitted by UNDP indicating that the phase out targets had been met (decision 59/36(c)). Decision 59/36(d) also requested UNDP to present annual progress reports on implementation of the project, including financial reports, until the project was completed.

Annual progress report

48. Validation tests were carried out on three cantaloupe and watermelon farms as part of the requirements for the registration of methyl iodine in Costa Rica. However, the commercial company had not initiated the registration procedure for the fumigant. A mission to Honduras was conducted to gather information on the biofumigation technology that has been introduced as a replacement for MB in the cultivation of cantaloupe and watermelon. A reciprocal mission from Honduras to two farms in Costa Rica was also conducted. As a result, the largest consumer of MB in Costa Rica decided to implement biofumigation technology. Meetings took place with the relevant authorities in late 2010 to ensure Government support for maintaining producers' compliance with the MB phase-outs targets. Of the total funding of US $4,845,283 so for approved, US $4,481,892 has been disbursed and the balance of US $363,391 will be disbursed in 2011 (US $255,000) and 2012 (US $108,391).

Further activities to be undertaken

49. The following activities are being proposed for 2011 with a budget of US $234,650: obtaining technical assistance for advice on transitioning from chemical to biological products; weed and disease control for cantaloupe and watermelon production; training programmes to farmers and public awareness/information dissemination activities; strengthening the bio-control production laboratory to support farms converting to bio-control technology; maintaining communication with the Government to ensure that the agreed MB phase-out target for 2011 is met; and monitoring the cantaloupe and watermelon harvest.

Secretariat's comments

50. According to the progress report submitted by UNDP, 169.3 ODP tonnes of MB were imported into Costa Rica which is below the level of 170.0 ODP tonnes established in the revised schedule agreed at the 59th Meeting. UNDP advised that the information on the amount of imports was obtained through the official licensing system and the permits that were issued by the Ozone Unit in 2010 and had been confirmed as correct by the companies using methyl bromide.

51. At the 48th Meeting, the Executive Committee requested the Government of Costa Rica and UNDP to include in all future work programmes, procedures for accelerating the introduction of full-scale alternative technologies in the melon sector (decision 48/16(b)(ii)). UNDP explained that the strategy to respond to the Committee's request had been to identify a successful example of alternative technology procedures and apply them in the Costa Rica project. UNDP is currently preparing a work plan using the successful example of the introduction of the biofumigation technology in Honduras that will allow the largest producer of melon and cantaloupe in Costa Rica to phase out MB in 2012. An expert from Honduras who has successfully assisted producers in Honduras will be hired as part of the work plan.

52. In regard to the use of methyl iodine, UNDP explained that less emphasis was being given to the use of this alternative fumigant since the importing company was not willing to provide information about future costs of the fumigant. Regarding the evaluation of methyl iodine, the importer indicated that the fumigant used in the evaluation tests had lost its effectiveness due to prolonged storage. Costa Rica is keeping the methyl iodine option open and would support its registration if it complies with requirements. Nevertheless the importer must play a more proactive role and thus currently more emphasis is being put on other alternatives.

Secretariat's recommendation

53. The Executive Committee may wish:

(a) To note the 2010 annual progress report on the implementation of the fifth tranche of the project for the total phase-out of methyl bromide (MB) used as a fumigant in melons, cut flowers, bananas, tobacco seedbeds and nurseries, excluding QPS applications, in Costa Rica;

(b) To note that the consumption of MB in Costa Rica in 2010 was below the maximum level of consumption indicated in the revised schedule for the phase-out of MB for the country;

(c) To authorize the disbursement of US $255,000 by UNDP to Costa Rica as part of the fifth tranche of the project;

(d) To request UNDP to present annual progress reports on implementation of the project, including financial reports, until the project was completed in accordance with decision 59/36.

Mexico: National methyl bromide phase-out plan (transfer of project) (UNIDO)

54. The Governments of Mexico and Canada have agreed to transfer to UNIDO the funding associated with the commodities component of the national methyl bromide (MB) phase-out plan for Mexico, with the exception of the first tranche of funding, which is currently under implementation by the Government of Canada (bilateral cooperation). Consequently, UNIDO as the lead implementing agency of the MB phase-out plan, has submitted a request to the 63rd Meeting to approve the transfer of US $500,000 plus agency support costs for the implementation of the second tranche at this Meeting; to approve the transfer from Canada to UNIDO of US $417,522 excluding agency support costs, associated with the 2012 and 2013 work programmes (third and fourth tranches); and to approve the revised agreed conditions for the phase-out of MB in Mexico taking into account these actions.

55. The request for the return of funds already approved is addressed in the document on report on balances and availability of resources (UNEP/OzL.Pro/ExCom/63/4). The modification to the agreed conditions for the 2012 and 2013 work programmes is attached as Annex I to the present document.

Background

56. The MB phase-out plan was approved at the 54th Meeting of the Executive at a total funding level of US $9,222,379, to be implemented by the Governments of Canada, Italy and Spain and by UNIDO in accordance the agreed conditions made between the Government of Mexico and the Executive Committee at the same meeting. The first (US $3,500,000) and second (US $3,300,000) tranches of funding were approved at the 54th and 60th Meetings.

Progress report

57. The first tranche of the commodities component of the phase-out plan will be substantially completed by April 2011. Activities proposed with the second tranche of funding include technical assistance and equipment for phosphine, sulfuryl fluoride and heat treatment applications. In total 31.5 ODP tonnes of MB will be phased out.

Secretariat's comments

58. The Secretariat noted that the transfer of the second and subsequent tranches of funds from the Government of Canada to UNIDO was consistent with the proviso to the conditions agreed at the 54th Meeting, i.e., that no further funding was being requested from the Fund for the phase-out of controlled uses of MB in Mexico.

Secretariat's recommendations

59. The Executive Committee may wish to:

(a) Approve the transfer of US $500,000, plus support costs of US $37,500 to UNIDO for the implementation of the second tranche of the phase-out of MB in commodities in Mexico;

(b) Approve the transfer from the Government of Canada to UNIDO of US $417,522, excluding agency support costs, associated with the 2012 and 2013 work programmes for the phase-out of MB in commodities in Mexico; and

(c) Approve the revised agreed conditions for the phase-out of methyl bromide in Mexico as attached to this document as Annex II to the present document.

Paraguay: Terminal phase-out management plan (TPMP) for Annex A Group I Substances (2008-2010 implementation report) (UNDP and UNEP)

60. On behalf of the Government of Paraguay, UNEP, as the lead implementing agency for the terminal phase-out management plan for Annex A Group I substances, has submitted to the 63rd Meeting of the Executive Committee a progress report on the fourth and final tranche.

Background

61. The TPMP for Paraguay was approved by the Executive Committee at its 51st Meeting, to completely phase out CFC consumption by 2009. Total funding of US $565,000 plus agency support costs of US $53,045 for UNEP and UNDP was approved in principle by the Executive Committee. At the same meeting, the Executive Committee approved the funding for the first tranche, and subsequent tranches were approved at the 58th (second and third) and 60th (fourth) Meetings. At the 60th Meeting, Paraguay was requested, with the assistance of UNDP and UNEP, to submit a progress report on the implementation of the work programme associated with the fourth and final tranche of the TPMP no later than the 63rd Meeting.

Progress report on the implementation of the fourth tranche of the TPMP

62. A cooperation agreement was signed by the Secretariat of the Environment (SEAM) and the Customs Office on enforcement of the ODS import licensing system and prevention of illegal trade. Since the last quarter of 2010, the Ozone Unit (NOU) has had access to the online customs system to approve ODS licenses and to provide timely information for import controls. Thirteen trainers and 10 customs officers received training. The NOU co-organized with UNEP a workshop in October 2010 with the aim of promoting coordination to address illegal trade issues amongst neighbouring countries including Argentina, Brazil, Chile and Uruguay. Good practices in refrigeration were promoted by means of strategic partnerships with government and educational institutions. The Association of Refrigeration Technicians (TRAP) participated in the development of work competency standards and the dissemination of training courses.

63. Thirty technical seminars on good practices and the use of alternatives were held and an additional 450 tool kits were purchased in June 2010 for distribution to refrigeration technicians as incentives. In total 679 technicians have been trained and 635 training kits distributed. Two thousand posters on good practices in refrigeration, 1,000 brochures about training courses and 1,000 technical specifications on drop-in alternatives were prepared and distributed to trainees. Two certification institutions were identified and once the system is in place 100 technicians will be certified during the first half of 2011. Some components are being incorporated into the HPMP to address the control and

monitoring of HCFC uses and equipment such as a management system for tracking HCFC uses in Paraguay.

64. As of December 2010, of the US $565,000 so far approved, US $441,681 had been disbursed or obligated, leaving a balance of US $123,319.

Activities planned for 2011 and 2012

65. The balance of funds remaining will be utilized in 2011 and 2012 to complete activities towards sustaining zero consumption of CFCs and facilitating the phase-out of HCFCs, including public awareness activities of the HPMP; train trainers in equipment retrofits (especially on the use of natural refrigerants and low global warming potential alternatives); provision of service tools to technicians and TPMP implementation, monitoring and control. In 2011, SEAM and the national customs will continue to monitor ODS imports (HCFCs and blends) and substitutes (HFCs and others) and develop a strategy with respect to the destruction of CFCs contained in equipment, consolidate the implementation of the electronic licensing system and establish the technicians certification system (100 technicians) in the refrigeration sector.

Secretariat's comments

66. In 2009, Paraguay reported consumption a CFC consumption of 10.79 ODP tonnes. Preliminary figures for 2010 show that CFCs were not imported into the country. The activities contained in the final tranche of the TPMP were not only focused on the goals of the TPMP but also on activities to sustain zero consumption of CFCs and facilitate the phase-out of HCFCs.

67. Upon a request for a clarification on the reason for the delay in the implementation of the certification scheme and the postponement of technician certification, UNEP explained that the delay was due to the lack of a national labour certification system to carry out the process. Consequently a number of possible certification bodies had to be identified and assessed. In April 2011 a training course developed by the National Training Service in Colombia will be held for evaluators and auditors regarding the refrigeration sector certification and the pilot certification process for 100 technicians is expected to be completed by mid 2011.

68. In regard to the delay in retrofitting the CFC-based equipment in two hospitals and to train 20 technicians, UNEP explained that that the delay was due to the lack of national capacity in the area of efficiency of alternative refrigerants vis-à-vis the high temperatures in Paraguay and the required cooling needs. As the main purpose of the project was to train 20 trainers to adopt low-GWP refrigerants, this activity would provide a unique opportunity to link CFC phase-out with HCFC phase-out. The hands-on training would build national capacity for future retrofitting programmes that may be undertaken during the HCFC phase-out period. Current systems using CFC-12 technology are being serviced from the national inventory of CFC-12.

69. Given the delays in the implementation of the TPMP, and that the Government of Paraguay has estimated zero consumption of CFCs (and that CFCs are no longer produced, thus reducing the risk of illegal trade), plus the limited time available to meet the HCFC compliance targets in 2013 and 2015, it was suggested that the remaining funds available under the TPMP could be used for activities related to strengthening/enforcing the licensing and quota systems and control of illegal trade of ODS (mainly HCFCs but also including CFCs), as well as for training of technicians in good service practices (addressing all refrigerants) and provision of tools. UNEP indicated that the suggestion was considered that it would be feasible to continue implementing information dissemination activities and to reinforce the component on prevention of illegal trade of ODS.

Secretariat's recommendation

70. The Executive Committee may wish to:

(a) Note the progress report on the implementation of terminal phase-out management plan (TPMP) for Annex A, Group I substances for the 2010 implementation period; and

(b) Request Paraguay to use the balance of funds remaining from the second, third and fourth tranches of the TPMP to complete the remaining activities to sustain zero consumption of CFCs and support other activities to facilitate the phase-out of HCFCs in Paraguay.

Sri Lanka: National compliance action plan (proposal for the utilisation of remaining funds) (Japan)

71. On behalf of the Government of Sri Lanka, the Government of Japan, as the lead implementing agency for the national compliance action plan (NCAP), has submitted to the 63rd Meeting a proposal for the utilisation of remaining funds under the NCAP of Sri Lanka.

Background

72. The NCAP for Sri Lanka was approved at the 43rd Meeting to completely eliminate the consumption of CFCs and halons by 2009. Total funding of US $1,015,000 plus agency support costs of US $86,502 for Japan and US $45,448 for UNEP was approved to be provided in a single tranche. At the end of December 2010, out of the total funding of US $665,400 approved for the components being implemented by Japan, US $174,395 had not been disbursed.

73. Two of the four components being implemented by Japan, recovery and recycling programme and MAC recovery, recycling and retrofit programme have been completed, and the third, monitoring the activities included in the phase-out plan, is not delayed. The fourth component, the incentive programme for commercial and industrial end-users, could not be completed in a timely manner for a number of reasons including applicants failing to provide the appropriate documentation for incentive payments, the fact that CFCs were available in Sri Lanka at competitive prices until its ban in 2008, and because most of the CFC-based commercial refrigeration systems in beach hotels and holiday resorts were replaced after the tsunami in 2004 with the financial incentives received from the Government. Furthermore, the Government of Sri Lanka indicated that phase-out activities for the North and Eastern provinces in Sri Lanka that were unable to commence or continue due to security issues can now proceed.

74. The Government of Japan proposed to UNDP in September 2010 that the remaining balances from the NCAP would be could be utilized to provide additional recovery and reclamation equipment and retrofit some 10 end-user refrigeration systems. The activities would be implemented by the NOU with support from UNDP. Training activities would be coordinated with local service technician associations and dealers in order to maximize its outreach.

Secretariat's comments

75. In 2008 and 2009 Sri Lanka reported zero consumption of CFCs and halons under Article 7 of the Montreal Protocol indicating that Sri Lanka has fulfilled its commitment to phase-out ODS in accordance with the phase-out schedule associated with the NCAP. The Secretariat also noted that the proposal for the use of the remaining funding under the NCAP is consistent with decision 60/11 that allows utilization of TPMP/NPP funding tranches for activities to sustain zero consumption of CFCs and other activities to facilitate the phase-out of HCFCs.

76. The Government of Japan proposes that the remaining balance of funds could be transferred to UNDP, the lead agency for the HCFC phase-out management plan (HPMP), for activities to support industry and consumers mainly in the North and Eastern region of Sri Lanka to phase out remaining CFC uses and HCFC phase-out activities.

77. At the 62nd Meeting the Executive Committee approved stage I of the HCFC phase-out management plan (HPMP) for Sri Lanka for the period 2010-2020, at a funding level of US $647,866 to be implemented by UNDP (US $398,866) and UNEP (US $249,000) to support HCFC phase-out activities in the servicing sector, investment project (manufacturing), and technical assistance activities for the refrigeration and air conditioning assembly sub-sector.

Secretariat's recommendation

78. The Executive Committee may wish to:

(a) Note the report from the Government of Japan on the proposal for the utilization of remaining funds under the National Compliance Action Plan (NCAP) of Sri Lanka;

(b) Approve the request by the Government of Sri Lanka, to continue the implementation of the phase-out activities approved under the NCAP to sustain zero consumption of CFCs and support other activities to facilitate the phase-out of HCFCs in Sri Lanka;

(c) To submit a final report on the implementation of the activities under the NCAP no later than the 66th Meeting of the Executive Committee.

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Annex I

The Demonstration Project of Wanhua Rongwei Formulated Polyols with Premixed Cyclopentane Blending Center

Safety Assessment Report

(The First Draft)

Nanjing Forest University

August 2010

Table of Contents

Introduction

In November 2009, the 59th meeting of "Montreal Protocol" Multilateral Fund Executive Committee approved a demonstration project of formulated polyols with premixed cyclo-pentane blending center in the polyurethane foam sector in China. To promote the smooth implementation of this demonstration project and cooperate with the preparation of the HCFC Phase-out Plan in the Polyurethane Foam Sector, the Foreign Economic Cooperation Office of the Ministry of Environmental Protection has initiated a technical assistance project of safety assessment of premixed cyclo-pentane and formulated polyols production, transportation and use.

The main objectives of the project are to: Carry out comprehensive studies and researches in producing, transporting and handling of blended polyols containing pentane; Test the safety data of blended polyols containing cyclo-pentane to provide a reference for the production, transportation, use and other sectors; Evaluation of Wanhua Rongwei and Minea Electrical Appliance's existing facilities, and give the recommendations on the reform plan; Compile Material Safety Data Sheet(MSDS) for blended polyols containing cyclo-pentane; Formulate the Safety Assessment Report on producing, transporting and using of blended polyols containing cyclo-pentane to guide operators in various sectors.

1. Technical Feasibility Analysis of Cyclopentane Substitution

After CFC-11 was eliminated, the refrigerator sector in China has been using cyclo-pentane as a physical foam blowing agent in the production of polyurethane foam. Compared with HFC, cyclo-pentane has a low global warming potential (GWP) with zero ozone depletion potential (ODP). It has a short lifecycle in the atmosphere and can truly meet the requirements of environmental friendly and fluorine-free. In the long run cost perspective, cyclopentane is the lowest cost alternative currently available. China has domestic cyclopentane production with low price; in terms of technology, there is extensive support from a large number of combined materials suppliers. Polyurethane foam can obtain good insulation properties under low density conditions by using cyclopentane as the foaming agent. Therefore, considering environmental and economic benefits, cyclopentane technology is considered as the final solution for most rigid polyurethane foam applications to replace HCFC-141b.

Cyclopentane is an alicyclic hydrocarbon with weak polarity, having poor solubility in most polyether polyols, therefore, compatibility between cyclopentane and polyether is the key technical issue to be solved when using cyclopentane as blowing agent. The compatibility can be improved in two ways, enhancement of the polyether structure and adding foam stabilizer.

1.1 Polyether polyols

The performance of polyether polyols has a close relationship with the starting agent and also related to the length of molecular chain and arrangement structure of oxidized olefin. There is a large variety and complex species of starting agents for polyether polyols synthesis; however, according to the distinction of active group nature, the initial agents for polyether polyols synthesis mainly include two categories, hydroxyl containing compounds and amine containing compounds. The most commonly used initial agents are propylene glycol, trimethylolpropane, glycerol, mannitol, sorbitol, pentaerythritol, sucrose, xylitol, ethylene diamine, triethanolamine, toluene diamine. In addition, aromatic polyether uses compounds such as bisphenol A, phenol - formaldehyde condensate, aniline - formaldehyde oligomers, 3 (hydroxyethyl) isocyanurate or the compounds of common starting agents. To obtain polyether polyols with appropriate nature of functionality and viscosity, etc, sometimes mixed starting agents are used for polyether production.

To address the solubility problems of cyclopentane in polyether, the polyether structure is usually improved to enhance the solubility of cyclopentane with low polarity in polyether. The selection of starting agent, polyether functionality, hydroxyl value and polyether water content, etc, will influence the cyclopentane solubility. Huntsman Company (former ICI Polyurethane) made detailed experimental study on the solubility of some polyethers, with the results shown in Table-1, both starting agents and hydroxyl values having some impact on cyclopentane solubility.

Table-1 The solubility of cyclopentane in some major polyethers

Polyol type	Hydroxyl value mgKOH/g	c-P solubility in polyols %
Sucrose polyether	440	16

Sucrose polyether	310	48
Sorbitol polyether	490	19
Glycerol polyether	540	18
Aromatic polyether	500	12
Aliphatic polyester	250	8
Aromatic polyester	347	2

Currently, there are a lot of polyethers used for cyclopentane foaming system in China; Manufacturers such as Guangdong Wanhua Rongwei, Nanjing HBL, Shandong Dongda have the product grades for cyclopentane foaming.

Table-2 Domestic representative polyethers for rigid foam

Supplier	Grade	Purpose
Guangdong Wanhua Rongwei	Wanefoam RCI36 series	Insulation materials of refrigerator and cold storage, etc.
	Wanefoam RCI36 series	
	Wanefoam RCI36 series	
Nanjing HBL	H563	Insulation materials of refrigerator and freezer, etc.
	H539	
	H577	
	H566	
Shandong Dongda	DCP-401	Insulation materials of refrigerator cold storage and freezer, etc
	DCP-402	

1.2 Foam stabilizer

In the process of plastic polyurethane foam, stabilizer is an indispensable assistant, it plays a role of foam material emulsion, foam stabilization and cell regulation, while increasing the component solubility.

The currently used foam stabilizers are mostly silicone surfactants; its main structure is polysiloxane-olefin oxide block copolymer, commonly known as “silicone oil” (note: they are not real silicone oil). There are a number of silicone foam stabilizers; the foam stabilizers for the foaming system of different flexible foams, rigid foams and HR foam have different structures,

generally containing duplicate dimethyl siloxane segment, ethylene oxide segment and propylene oxide segment.

In the block copolymer, olefin polymer oxidation is a hydrophilic segment and polysiloxane is a hydrophobic segment; therefore, they can well mix and emulsify each component into a homogeneous system and enable various reactions to process in balance. It can meet different production requirements by regulating relative molecular mass, functionality and polyether copolymer, etc. Changing the proportion and arrangement sequence of ethylene oxide polymers and propylene oxide polymers in polymer segment, regulating the polarity of foam stabilizers can change the foam stabilizer emulsifying performance thereby improve the solubility of cyclopentane in polyether.

Currently, there are a number of foam stabilizer grades in the market, the customer can choose suitable foam stabilizer according to different foaming system. Foam stabilizers such as the B8510 and B8462 of German Evonic, the DC5580 and DC5598 of Air Products, L-6840 of Momentive, as well as AK8830 and AK8818 of Nanjing Dymatic Shichuang Co., Ltd can be used for cyclopentane foaming system.

In actual production and application, according to the actual application, improve polyether structure and select suitable foam stabilizer to make formulated polyols form a stable and homogeneous system thereby improve the storage stability of mixed components.

1.3 Stability testing of premixed formulated polyols

There are a number of polyols suppliers in China that provide dry formulated polyols for cyclopentane foaming system. We conducted sampling and require 6 manufacturers, namely, Guangdong Wanhua Rongwei, Jiangsu Lvyuan, Nanjing HBL, Shandong Dongda, Changshu Yitong and Jiangyin Youbang, to provide 16 representative grades of dry formulated polyols for the downstream customers that using cyclopentane foaming system. We prepared the collected polyols into samples with different contents of cyclopentane in the laboratory and entrusted Jiangsu Research Institute of Product Quality Supervision and Inspection to carry out test on stability of the samples. The prepared formulated polyols were put into test tubes and sealed, the storage stability in different temperatures were tested, The formulated polyols with good compatibility have high system storage stability and no stratification occurred in low temperatures. The test temperatures are -5℃, 0℃, 5℃, 10℃, 15℃, 20℃ and 25℃ respectively.

It is observed whether there is stratification after 48h's storage in each temperature to judge its stability. The selected mass ratio of formulated polyols and cyclopentane are 100:13 and 100:15, which currently are equivalent or even higher than the rates of using of blended polyols with cyclo-pentane as blowing agent.

Table-3 Stability test of cyclopentane formulated polyols (the mass ratio of formulated polyols and cyclopentane is 100:13)

Product serial No.	Test Results						
	25℃	20℃	15℃	10℃	5℃	0℃	-5℃
WH 1#	A little turbid	Turbid	Turbid	Turbid	Turbid	Stratified	
WH 2#	Transparent	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified
WH 3#	Turbid	Turbid	Turbid	Turbid	Turbid	Stratified	
WH 4#	Turbid	Turbid	Stratified				
WH 5#	Transparent	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid
LY(XF)	A little turbid	Turbid	Turbid	Turbid	Turbid	Stratified	
LY(HR)	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Hongbaoli H524	Transparent	Transparent	Transparent	Transparent	Stratified		
Hongbaoli H543	Transparent	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified
Dongda 1#	Transparent	Transparent	Transparent	Transparent	Stratified		
Dongda 2#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Dongda 3#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Yitong 3018	Turbid	Turbid	Turbid	Turbid	Stratified		
Yitong 3030	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid	Stratified	
Youbang 1#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Youbang 2#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	

Table-4 Stability test of cyclopentane formulated polyols (the mass ratio of formulated polyols and cyclopentane is 100:15)

Product serial	Test Results

No.	25℃	20℃	15℃	10℃	5℃	0℃	-5℃
WH 1#	A little turbid	Stratified					
WH 2#	Transparent	A little turbid	A little turbid	A little turbid	A little turbid	Stratified	
WH 3#	Turbid	Turbid	Turbid	Stratified			
WH 4#	Turbid	Turbid	Turbid	Stratified			
WH 5#	Turbid	Turbid	Turbid	Turbid	Turbid	Stratified	
LY(XF)	Turbid	Turbid	Turbid	Turbid	Turbid	Stratified	
LY(HR)	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Hongbaoli H524	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Hongbaoli H543	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Dongda 1#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Dongda 2#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Dongda 3#	Transparent	Transparent	Transparent	Transparent	Stratified		
Yitong 3018	Turbid	Turbid	Stratified				
Yitong 3030	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid	A little turbid
Youbang 1#	Transparent	Transparent	Transparent	Transparent	Transparent	Stratified	
Youbang 2#	Transparent	Stratified					

Table-3 and Table-4 shows the results of stability test. It is shown that most stratification of the 16 grades of formulated polyols occurs at 0℃, with good stability. Only a handful of samples have poor compatibility with cyclopentane, with high stratification temperature. This is showing that the domestic polyether suppliers have basically solved the compatibility issue of cyclopentane and polyether. In the sample test of Wanhua Rongwei, the 5# sample (Mass ratio of formulated polyether and cyclopentane is 100:13) has outstanding stability without stratification at -5℃, indicating good compatibility of polyether and cyclopentane; meanwhile, also proving Wanhua Rongwei can technically solve the compatibility issue.

2 Safety Test of Formulated polyols with premixed cyclopentane

Cyclopentane is a highly flammable chemical; its vapor can form explosive mixture with air, easy to burn and explode with open flame and heat. Strong reaction will occur when contacting with oxidants, or even cause combustion, so the heated containers have explosion hazard. Its vapor is heavier than the air, can spread afar at a low height, and will cause an explosion when meets fire.

Polyether is a flame retardant chemical, while the hazard of formulated polyols will significantly increase after adding the highly flammable and explosive cyclo- pentane; there are more strict requirements on the security measures of premixed cyclopentane and formulated polyols production, storage and use; therefore, it is necessary to test the security data of formulated polyols with premixed cyclopentane so as to assess the overall security.

Table-5 The physical and chemical properties of cyclopentane

Melting point(℃):	-93.7
Boiling point (℃):	49.3
Relative density (water = 1):	0.75
Relative vapor density (air = 1):	2.42
Saturation vapor pressure (kPa):	53.32(31)
Heat of combustion (kJ / mol):	3287.8
Critical temperature (□):	238.6
Critical pressure (MPa):	4.52
Logarithm value of octanol / water partition coefficient values:	7 (calculated value)
: Flash point (℃):	-25
Ignition temperature (℃):	361
Explosive limit(volume)	1.4%~8.0%
Solubility:	Insoluble in water, soluble in most organic solvents such as in alcohol, ether, benzene, carbon tetrachloride, acetone, etc.

2.1 Test of flash point

Flash point means, in specified conditions, heat the flammable liquid to the minimum temperature of instant ignition caused by the contact of its vapor and flame. Flash point is divided into open flash point and closed flash point; without specification, the general flash point is closed flash point. The hazardous levels of flammable liquid are classified according to the closed flash point. The fire hazard of flammable liquid can be identified according to the flash point, having great significance in production and application. Flash point is an item showing flammable liquid evaporation tendency and security nature. The hazardous levels of flammable liquid are classified according to the flash point; these with closed flash points below 45□ are called flammable products and these above 45□ are called combustible products.

In specified conditions, heat cyclopentane formulated polyols, when the oil temperature reaches a certain point, the vapor of cyclopentane formulated polyols mixes with the surrounding air; once contacting flame, flash fire phenomenon will occur; the minimum flash fire temperature is the flash point of formulated polyols with cyclopentane.

The equipments for flash point test must be in line with the existing national flash point testing standards; the current national standard of open flash point is GB/T 3536-2008 Petroleum products—Determination of flash and fire points—Cleveland open cup method; and that of the closed flash point is GB/T261-2008 Determination of flash point—Pensky-Martens closed cup method. The SYD3536 Cleveland open flash point instrument and SYD261 closed flash point instrument of Shanghai Changji Geological Instrument are selected for the open flash point test and closed flash point test.

Table-6 Open flash point of formulated polyols with cyclopentane (Unit: ℃)

Product	Mass ratio of fomulated polyether and cyclopentane					
Serial No.	100:5	100:7	100:9	100:11	100:13	100:15
WH 1#	—	—	55	51	45	43
WH 2#	—	—	54	51	46	40
WH 3#	—	—	57	49	46	42
WH 4#	—	—	53	46	43	42
WH 5#	—	—	56	47	44	42
LY(XF)	—	—	49	46	42	37

LY(HR)	—	—	51	45	42	39
Hongbaoli H524	—	—	50	46	42	40
Hongbaoli H543	—	—	57	49	41	38
Dongda 1#	—	—	54	49	39	32
Dongda 2#	—	—	54	50	41	34
Dongda 3#	—	—	56	50	42	37
Yitong 3018	—	—	55	52	48	42
Yitong 3030	—	—	57	50	46	43
Youbang 1#	—	—	56	48	45	40
Youbang 2#	—	—	55	46	44	40

Table-7 Closed flash point of formulated polyols with cyclopentane (unit: ℃)

Product	Mass ratio of formulated polyether and cyclopentane					
Serial No.	100:5	100:7	100:9	100:11	100:13	100:15
WH 1#	26	25	12.7	8.7	6.3	0.7
WH 2#	21.7	15.7	13.3	8.3	4	-0.7
WH 3#	20.7	16.7	14.3	8.3	6	0.7
WH 4#	19	14.3	10.3	7.3	3.7	1.3
WH 5#	22	16.3	12.7	10	1.3	0
LY(XF)	22.3	14	9.7	10	4.3	1
LY(HR)	20.7	17.7	15.7	10.7	5.7	0.7
Hongbaoli H524	14	12	11.3	11	0	-1.7
Hongbaoli H543	14	12.3	11	6.3	4	-1.3
Dongda 1#	12.3	10	8.7	7	2.3	-2.3
Dongda 2#	12.3	9	7.7	6	0	-2.3
Dongda 3#	10.7	9.3	5.3	4.3	3	-1.3
Yitong	15.7	13.3	11.3	8	5	3

3018						
Yitong 3030	14.3	11.3	8	5.7	-3	-5.3
Youbang 1#	17	13.3	11	6	3	-1
Youbang 2#	16.7	10	6	3	1.7	0

With the increasing content of cyclopentane, the flash point of formulated polyols decreased, the flammability is significantly increased; therefore, high requirements are put forward on the security measures in production. The open flash test is largely subjected to the environmental factors; in well-ventilated environment, the volatile cyclopentane vapor has fast diffusion speed, therefore, the measured figure is usually high. It shows that in the storage of formulated polyols with premixed cyclopentane, it is necessary to ensure a well-ventilated storage workshop. Closed flash point is mainly used to assess the security level of flammable liquid; according to the test results, it can be confirmed the security level of formulated polyols with premixed cyclopentane is **class II flammable liquid**, thereby the safety standard, transportation and storage requirements are determined on this classification.

2.2 Vapor pressure test

Vapor pressure refers to the vapor of the substance on the surface of the liquid or solid; the pressure generated by such vapor on the liquid (or solid) surface is known as the liquid (or solid) vapor pressure. Some molecules with kinetic energy from the liquid at a certain temperature keep on escaping from the liquid surface and become vapor; this process is known as evaporation; meanwhile, some vapor molecules return to the liquid and this process is called condensation. When the rate of evaporation is the same as that of condensation, the dynamic equilibrium is achieved; the vapor pressure is the liquid saturated vapor pressure at such temperature.

The vapor pressure of formulated polyols with premixed cyclopentane is primarily generated by cyclopentane vapor; test the vapor pressure data of formulated polyols to determine the storage standards of formulated polyols with premixed cyclopentane. The test material is the formulated polyols (Mass ratio of formulated polyether and cyclopentane is 100:15) and the test method is GB/T 21616-2008 Dangerous Goods Test Method for Vapor Pressure of Flammable liquids; that is, directly test the saturated vapor pressure at a certain temperature.

Table-8 The saturated vapor pressure test of premixed cyclopentane and formulated polyols (Unit: kPa)

Product serial No.	Test Temperature						
	30℃	35℃	40℃	45℃	50℃	55℃	60℃
WH 1#	48.91	51.35	58.43	68.05	76.27	86.74	92.61
WH 2#	45.9	52.77	59.6	65.12	68.5	78.9	91.67
WH 3#	51.37	58.39	61.61	67.62	76	87.15	96.86
WH 4#	51.34	57.47	63.09	70.35	76.7	87.54	100.18
WH 5#	59.15	62.02	64.32	69.35	78.99	87.44	95.61
LY(XF)	52.32	59.66	63.36	65.48	69.1	72.17	80.13
LY(HR)	58.43	63.64	65.77	70.25	80.42	88.96	97.55
Hongbaoli H524	53.9	59.05	63.04	66.17	72.97	78.15	82.54
Hongbaoli H543	51.11	56.32	62.89	69.16	78.1	84.01	92.44
Dongda 1#	47.81	53.5	59.19	66.78	77.76	86.12	89.16
Dongda 2#	50.29	56.07	59.02	66.54	70.81	77.98	84.58
Dongda 3#	50.31	57.64	61.42	68.29	71.81	78.5	85.17
Yitong 3018	50.9	57.55	61.26	68.1	76.39	83.47	89.47
Yitong 3030	52.91	58.16	63.3	67.2	74.82	79.66	90.46
Youbang 1#	51.07	56.48	62.41	68.86	73.78	82.77	92.3
Youbang 2#	50.97	57.32	61.65	66.65	70.53	77.23	85.01

The vapor pressure of formulated polyols is an important reference for determining premixing conditions and storage conditions. According to test results, the sample with the largest saturated vapor pressure is the 4# sample of Wanhua Rongwei; at 60□, its saturated vapor pressure is 100.18 kPa, close to atmospheric pressure. In the actual production process, equipments such as the pipeline, formulated polyols tank and transportation tank should keep a certain pressure to ensure the safety of production and application process. The packaging of blended polyols with cyclo-pentane can be 200L galvanized metal tanks or 500~1000L pressure steel tanks. If using galvanized metal tanks, the proposed tanks' thickness are not less than 1.22mm. The tanks must be welded assembly to ensure that the tanks can withstank the

pressure of not less than 200kPa. Rongwei Company uses nitrogen 150 kPa pressure packages for formulated polyols tank, which can ensure the safety in transportation.

3 The Implementation Program of Wanhua Rongwei Premixed Cyclopentane and Formulated Polyols Production Line Transformation

3.1 Basic conditions

3.1.1 Geographical location (with the map of the plant and surrounding environment)

Guangdong Wanhua Rongwei Polyurethane Co., Ltd is located in the Industrial Zone, Mingcheng Town, Gaoming District, Foshan, Guangdong, in central and southern Guangdong Province, the northwest part of Pearl River Delta area, west Foshan City, with convenient traffic. See the picture below for plant surrounding environment; the project construction site has the security conditions for cyclopentane tank.

3.1.2 Raw materials (source of the substitutes and production raw materials)

Currently, the domestic suppliers such as Foshan Shunde Meilong Cyclopentane Chemical Co., Ltd, Beijing Eastern Acrylic Chemical Technology Co., Ltd and Shenzhen Esson Industrial Co., Ltd, purchase cyclopentane to substitute HCFC-141b.

Polyether polyols raw materials are mainly produced by the companies, with small purchase quantity; catalysts are mainly purchased from Air Products Company, Jiangsu Dajiang Chemical Co., Ltd and Jiangsu Liyang Chemical Co., Ltd, etc; and the silicone surfactants suppliers are Evonik, Momentive and Nanjing Dymatic Shichuang Co., Ltd.

3.1.3 Power supply

The plant has 300kwA transformer, providing normal production electricity.

3.1.4 Water supply

The plant has running water and fire water supply pipes, provided by the municipal supply department.

3.1.5 Stream supply

The plant has a 4-tons' boiler, providing steam for normal production.

3.1.6 Compressed air

The plant has air compression and nitrogen system, providing gas source for production and nitrogen protection.

The above basic conditions can meet the requirements of premixed cyclopentane and formulated polyols production.

3.2 Project implementation plans and security measures

3.2.1 Overview of production methods

Guangdong Wanhua Rongwei Polyurethane Co., Ltd uses the mixture of cyclopentane and premixed formulated polyols to provide premixed cyclopentane and formulated polyols material for small household electrical appliance enterprises. The cyclopentane and polyols were sent from their storages to the static premix station by pumps; the mixed polyols with cyclopentane were then sent to the mixing tank to continue blending, and then conduct packaging, storage and transportation.

3.2.2 Newly added equipments

Wanhua Rongwei plans to prepare a complete set of facilities of premixed cyclopentane combined material; the newly added equipments include:

Table-9 List of the newly added equipments

No.	Type of Equipment	Piece (set)
1	Tank for Cyclopentane 35m^3	1
2	Pump for Cyclopentane	2
3	Tank for dry combined polyols	2
4	Pump for dry combined polyols	2
5	Premixed device	2
6	Tank for premixed polyols	2
7	Pump for premixed polyols	2

8	Semi-automatic filling machine	2

At the same time, the company will conduct conversion and retrofitting to power distribution, equip safety, fire prevention facilities and necessary plant civil reconstruction.

3.2.3 Electricity, fire and ventilation transformation

a. Electricity

In accordance with the process requirements, the production category of workshop transformation is Class A, implement "GB50058-92 Code for Design of Electric Installations within *Explosion* and Fire Hazard Atmospheres" and QB/T2911-2007 Light Industry Standards of the People's Republic of China. All electrical equipments in the workshop are explosion-proof, and set cyclopentane concentration detectors in special positions during the production process such as cyclopentane storage tank zone, cyclopentane premixed zone, formulated polyols with premixed cyclopentane filling zone and finished goods warehouse of formulated polyols with premixed cyclopentane.

The surplus 30KW of Rongwei Company's existing 100KW standby diesel generator can meet the application requirements of new projects and ensure the dual power supply requirements of fire and ventilation facilities.

b. Fire prevention

According the process requirements, the workshop production category is class A, Cart powder fire extinguishers should be equipped and foam fire hydrant need to be equipped outside of the workshop. Since the workshop is only 2km to Mingcheng fire brigade, the corresponding fire fighting facilities of the fire brigade can be used by the company, an independent foam station is not necessary. According to the equipment layout zone provided by the process, the mixed water is 16t/h and the foam preparation water pipe diameter is Φ100.

Cyclopentane tank water spray cooling, with the water volume of 9.94L/S. Circulating cooling water system needs to be added.

c. Ventilation

Workshop transformation should follow the requirement of Class A, the plant should be considered according to the running-through of the first and second floor, all fan motors are explosion-proof.

Building, fire, power supply, electricity and ventilation should implement "GB50016-2006 Architectural Design Code for fire Protection", "GB50058-92 Code for Design of Electric Installations within *Explosion* and Fire Hazard Atmospheres" and QB/T2911-2007 Light

Industry Standards of the People's Republic of China and apply the safety specifications of cyclopentane foam production of household and similar electrical appliances.

3.2.4 Storage tank for cyclopentane and security measures

Cyclopentane storage system is mainly composed of cyclopentane storage tank, discharge system, liquid level control system, respiratory balance system, electronic control systems and piping system. The newly built cyclopentane storage tank is a $35m^3$ pressure vessel with the design and manufacturing in line with national Class□pressure vessel standards; the tank is in double layer and filled with ethylene glycol in the interlayer, for cyclopentane leakage alarm. The newly built cyclopentane tank is planned to place in the vacant original Class A tank zone, which can fully utilize the existing cooling and sprinkler system to ensure the safety of storage and reduce investment cost.

The configuration of each part and technical specifications are as follows:

Tank (inner and outer layer), the connection between the tank and external part by upper and lower flanges and necessary connection accessories; there is a tank support saddle below, and hanging ears in the top for hoisting.

a. Cyclopentane storage system technical requirements:

(1) The tank is a Class II pressure vessel, which is designed, manufactured and tested according to the pressure vessel code.

(2) The design and manufacture of pressure vessel are in line with GB150—1998 "Steel Pressure Vessel" and the requirements of "Pressure Vessel Safety Technology Supervision" issued by the Ministry of Labor.

b. Discharge system

The discharge system is mainly used to add the cyclopentane in the tanker into the $35m^3$ tanks; it mainly consists of the following parts:

- The feeding well equipped with feed control valve and connection hose
- The hose and jaw coupling connecting the tanker discharge port
- Gas replacement hose and jaw coupling connecting the tanker balance port
- Safety valve
- Pneumatic control unit

c. Liquid level control system

Float liquid level gauge is used to monitor the tank's liquid level and there is a liquid level display in the control cabinet; when the liquid level is at the highest or the lowest, that is, only

20% left, the electronic control system will alarm, stopping feeding at the highest liquid level and shutting down at the lowest level; 20% liquid level prompts for feeding; the operator should take appropriate measures depending on the circumstances.

Auxiliary tank uses a set of float liquid level gauges to monitor the liquid level in the tank.

The liquid level in discharge system, material transfer system (auxiliary tank), transporting system (main tank) uses automatic control.

d. Hazardous gas monitoring and safety control system

Respectively install 1 hazardous monitoring probe on the cyclopentane tank feeding well and output well, sharing one alarm cabinet; the concentration alarm signals gathered by hazardous monitoring probe will be collected and processed by electrical control cabinet response template.

Alarm parameters setting: the alarm light flashes when the volume fraction of cyclopentane in the air reaches 20% of the lower explosive limit (LEL), and the control cabinet displays the point of failure; up to 40% of LEL, there will be sound and light alarm, the control cabinet will show the failure point; after eliminating failures and conduct necessary maintenance, the operator conducts equipment reset for re-operation.

e. Glycol anti-leakage monitoring alarm system

To monitor the tank cyclopentane leakage, fill the tank interlayer with glycol and set a glycol tank on the top of the storage tank; connect the pipe with the interlayer and install liquid level device on external glycol tank to monitor cyclopentane leakage by the change of glycol liquid level; when the actual level exceeds the set range, the control system will alarm and stop operation, then the operator should take appropriate emergency measures. Glycol is only combustible in case of fire, heat and strong oxidants, and it does not generate safety hazards by itself.

The main tank and auxiliary tank share one set, connected by pipe and ball valve.

f. Respiratory balance and nitrogen intake system

Realized by the balancing valve and saturated device on the tank top, when the main liquid level decreases, the nitrogen forms the saturated gas with the pipeline in the tank by the above-mentioned devices to achieve pressure balance.

The main tank and auxiliary tank share one set, connected by pipe and ball valve.

Once the nitrogen enters the tank by a set of decompression devices; the devices use second decompression to control the inlet pressure within 0.03bar; there is pressure detection sensor and safety valve on the gas inlet device to ensure the pressure within the set range

g. Electrical control system

A set of control systems are used for the automatic control of main tank and auxiliary tank material discharge, transfer, transportation and safety, etc, in cyclopentane filling zone.

h. Internal pipelines and cables

Pipeline system includes the tank's internal cyclopentane pipeline, nitrogen pipeline and compressed air pipeline; argon arc welding is used in cyclopentane pipe welding; leakage test is conducted according to the pressure pipeline code, protective treatment such as antistatic and equipotential grounding are conducted for all pipelines.

Between cyclopentane tank and premixed formulated polyols workshop, cyclopentane transfer pipeline will adopt overhead and single-tube format. Install fire damper on cyclopentane pipeline after entering the workshop and ensure the cyclopentane in the pipeline between fire damper and premixed station to be in high pressure state. Such cyclopentane transfer pipeline meets TUV safety code.

3.2.5 Cyclopentane premixed workshop transformation and premixed system

The current workshop of Guangdong Wanhua Rongwei Polyurethane Co., Ltd is in a plant of separate frame. In the general layout, the original workshop was noted with Class A production type, which made construction application and passed the acceptance of the local fire brigade. The transformation is to avail the original workshop and makes appropriate civil reconstruction to ensure the construction in line with the existing national requirements of Class A production workshop of "Architectural Design Code for Fire Protection" .The specific transformation measures are as follows:

First, in the original workshop with partition wall, avail some space in the north to block the doorway between the north workshop and south workshop as an anti-explosion wall; meanwhile, avail this space to separate the open staircase, distribution room and control room in south Class A production workshop to meet fire protection requirements.

Second, on separated formulated polyols with premixed cyclopentane workshop, cancel the cement floor of the second floor, retain the structural beams, use gird plate to connect with the first floor thereby facilitate the maintenance of cyclopentane static mixer.

Use static mixer for cyclopentane premixed device. Use dual pneumatic diaphragm pump to send the cyclopentane to the polyol/ cyclopentane premix station; one for standby and one for operation.

Conduct automatic measurement control on the cyclopentane entering premixed system; a German flow meter is installed on the cyclopentane transfer main pipe to conduct accurate measurement on cyclopentane, with the measurement error less than 1%; when reaching the set value, the system will automatically shut down and stop feeding.

Safety facilities of cyclopentane static premix devices: install surrounded house, cyclopentane gas detector and ventilation facilities of explosion-proof motor.

The cyclopentane formulated polyols mixed by static mixer is transported to the 1500L carbon steel jacketed intermediate tank.

Table-10 Safety measures of the intermediate tank

Serial No.	Safety device	Quantity (set)	Function	Remark
1	Safety valve	1	Release pressure when tank pressure exceeds the safety limit	
2	Manual exhaust valve	1	Regulate pressure inside the tank	Quick exhaust valve
3	Magnetic sensor	4	▲ Minimum alarm: ensure the alarm for minimum raw material in the tank. ▲ Start infusion: send signal to the premixed station to start feeding. ▲ Stop feeding: stop feeding when reaching the required amount. ▲ Maximum alarm: the safety limit of raw material in the tank.	
4	Manual switching valve	1	Manually control input direction	This set of valves are in close state during maintenance
5	Air pressure indicator meter	1	Indicate air pressure in the tank	
6	Discharge valve	1	Use for discharge or collect raw material samples	
7	Control valve	1	Control raw material adding	
8	Check valve	1	Control raw material input direction	
9	Manual ball valve	1	Connect input pipeline and manually control input	
10	Surrounded pool	1	Collect raw material in accidental leakage	Below the intermediate tank, and the volume is

				1500L, with security alarm device and discharge valve
11	Cyclopentane gas detector	1		
12	Ventilation device	1		Explosion-proof motor

3.2.6 Formulated polyols with premixed cyclopentane filling system

Use semi-automatic filling machine with nitrogen facilities; the filling equipment meets the following requirements:

1) Weight range: ≤ 300kg (adjustable); division value: 100g; measurement, review accuracy: ± 0.1% F·S.

2) Container standards: 200L galvanized iron barrel (height: 900 ± 15mm, diameter: 590 ± 15mm), mass 21kg, pressure 2.0kg/cm^2.

3) Explosion-proof grade: d □ BT4

4) Operating temperature: -10 □ - +40 □

5) Medium temperature: ≤ 100 □

6) Material viscosity :300-1000mpas / 25 □

7) Filling the system uses all stainless steel structure; PTFE is used as sealing material, the pressure of nitrogen gas packaging is 1.5kg/cm^2.

8) The system is equipped with a ventilation interface, effectively removing harmful gas accumulated within the system.

9) Ground installation, easy to maintain and operate.

10) Below the filling location, install surrounded pool to collect raw material in accidental leakage. The surrounded volume is 200L, with security alarm and discharge valve.

11) Install cyclopentane gas detectors.

Appendix

Table-11 Intrinsic cyclopentane gas detection and collection device statistics of formulated polyols with premixed cyclopentane transformation project

Serial No.	Device	Quantity	Installation position	Remark
1	Cyclopentane gas detector	6	▲ Cyclopentane storage tank area (4) ▲ Static mixer (1) ▲ Intermediate tank (1)	
2	Safety box	1	▲Static mixer	
3	Surrounded pool	2	▲Static mixer ▲Intermediate tank	Static mixer surrounded pool should be provided by equipment supplier

Table-12 The suggestion of adding cyclopentane gas detection and collection device statistics of formulated polyols with premixed cyclopentane transformation project according to the safety accessment

Serial No.	Device	Quantity	Installation position	Remark
1	Cyclopentane gas detector	4	▲ Filling zone (2) ▲ Finished products warehouse (2)	
2	Surrounded pool	1	▲ Filling zone	

4 Assessment for Transportation Safety of formulated polyols with premixed cyclopentane

Formulated polyols with premixed cyclopentane is categorized as Grade II flammable liquid referring to the testing result of closed flashing point for formulated polyols with premixed cyclopentane according to standards of public security industry of the People’s Republic of China, GA/T 536.1-2005, Grading and test method on fire hazard for flammable and explosive hazards -Part 1: Grading on fire hazard for flammable and explosive hazards. Therefore, formulated polyols with premixed cyclopentane must be managed and transported considering as flammable and dangerous goods. Formulated polyols with premixed cyclopentane transportation must meet the following requirements as specified Regulations on the Control over Safety of Dangerous Chemicals and Regulations on the Control over Dangerous Goods Transportation by Road:

(1) The consignor for formulated polyols with premixed cyclopentane by road transportation must authorize the qualified carrier for dangerous chemicals transportation. The personnel engaging into dangerous chemicals transportation e.g. driving, loading/unloading managing personnel, escorting personnel etc must pass the examination organized by the transportation administration. They can go to their posts upon their qualifications.

(2) The vehicles, vessels, loading/loading machinery and tools shipping formulated polyols with premixed cyclopentane must comply with JT3130-88, Rules of Transportation of Dangerous Goods by Vehicle issued by the Ministry of Communication of the People's Republic of China, passing examination and approval of the road transportation authority. The exhaust gas pipe of the vehicle carrying these goods must be provided with fire retarded device. Don't use the mechanical equipment and tools easily generating sparks when loading/unloading. Apply signs and identification lamps as specified by GB13392-2005, The Vehicle Marks for Road Transportation Dangerous Goods for the vehicles carrying formulated polyols with premixed cyclopentane.

(3) The transportation vehicle shall be provided with approximate types and quantities of fire extinguisher and leakage emergency handling equipment during transportation. The vehicle shall be provided with ground chain and provided with corresponding measures to lash the packaging containers to prevent that the containers from moving during transportation.

(4) Don't load and ship it together with such chemicals as oxidization agent. Avoid direct sunlight, rain, and high temperature during transportation, preferably transported in the morning and in the evening in summer. Keep far away from flame, thermal source, and high temperature zone when pausing.

(5) Drive the vehicle as specified lines when transporting by road. Don't stop it at the residential quarters and the area with high population density. The vehicle shall run at a medium speed. The road transportation distance shall be within 500km for formulated polyols with premixed cyclopentane.

(6) Humping is not allowed for railway transportation, and transport it through containers. It must not be transported with a wooden vessel or cement vessel in bulk way.

5 Assessment for Usage Safety of formulated polyols with premixed cyclopentane —Minea Electrical Appliance Co., Ltd, a Demonstrated Project

Over recent year, some formulated polyols enterprises have tried to properly prepare formulated polyols containing carbon hydrogen foaming agent within formulated polyols enterprises and supply them to the PU foam enterprise for production of foam. Through this technology, the carbon hydrogen foaming agent storage tank and tank farm, the carbon hydrogen foaming agent and dry formulated polyols mixing device which generally set up in PU foam enterprise have been transferred to the formulated polyols production enterprise. Through this technological method, the foam enterprise may supersede HCFC-141b with cyclopentane under a prerequisite that the plant or location is unneeded to be changed. Pre-mixed cyclopentane combination project can solve this problem.

For this project, the pre-mixing capacity is established by Wanhua Rongwei, an upstream enterprise and it prepared for further promotion of pre-mixed cyclopentane combination and then provides pre-mixed cyclopentane combination to the four downstream enterprises such as Minea Electrical Appliance Co., Ltd for purpose of replacing HCFC-141b.

5.1 Basic Conditions

Minea Electrical Appliance Co., Ltd is an enterprise that professionally engages into semi-conductor wine cabinet, semi-conductor refrigerator, semi-conductor beer brewer, and the other semi-conductor refrigerating product.

5.1.1 Raw material

The alternative technology of this project is to supersede HCFC-141 using cyclopentane as a foaming agent. The formulated polyols containing cyclopentane is directly purchased from Wanhua Rongwei. For purpose of production safety, Minea Electrical Appliance Co., Ltd has purchased formulated polyols with premixed CP of which quantity must be allowed by the fire fighting department each time.

5.1.2 Power supplying facilities

At present, there is one 260 kVA electric power transformer which has sufficient power supplying capacity and can ensure to meet requirements of implementation. For construction of demonstrated project, the transmission line needs to elevated (with pre-embedded cable) to the

site from the electrical distribution room. This project is provided with limited capacity newly added. Only the existing foaming machine is updated as pentamethylene foaming machine. Furthermore, some exhaust air equipment and carbon hydrogen concentration alarm device.

5.1.3 Water supply

This project locates within Tongan Industrial Park, Dongfeng Town, Zhongshan City, Guangdong Province, PRC. There, domestic water and fire water is centrally supplied. The fire pipeline has a DN250 diameter. There are 14 fire hydrants in the whole plant. The fire pipeline shall be laid according to the requirements of the fire authority and pass acceptance.

5.1.4 Air supply

Air shall be supplied by the air compressors located in the other workshops and transferred to the foaming area via pipeline to be used for startup of foaming die.

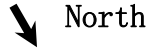
The basic requirements of Minea Electrical Appliance Co., Ltd can meet the requirements of the demonstrated project phasing out HCFC-141b.

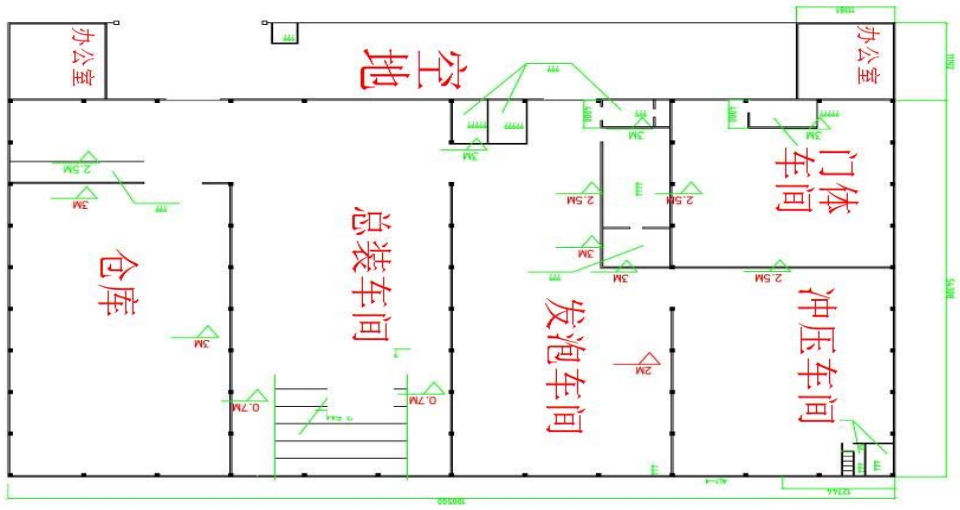
5.2 Implementation scheme for formulated polyols with premixed cyclopentane production transformation of Minea Electrical Appliance Co., Ltd

Minea Electrical Appliance Co., Ltd shall transform the production equipment and auxiliary facility according to foaming technical requirements of cyclopentane.

5.2.1 Transformation of production workshop

For this project, 162m^2 partition solid wall needs to be constructed for isolation of foaming working area and the stamping workshop, provided with a formulated polyols with premixed cyclopentane storage room, laid with a ground exhaust air duct in 30m length used for ventilation and exhaust of foaming die during production. It is provided with a cold and hot pipeline in 60m length for cooling and heating the foaming die during production. Some necessary facilities shall be added depending on requirements of exhaust equipment etc. The layout after transformation shall be as follows:





5.2.2

Transformation of power supplying facilities

At present, there is one 260 kVA electric power transformer which has sufficient power supplying capacity and can ensure to meet requirements of implementation. For implementation of this project, cable channel and tray shall be installed for the foaming area of foaming workshop and formulated polyols with premixed cyclopentane warehouse, laid with wires and cables, provided with explosion-proof lighting facilities. The existing cold and hot water machines are laid with parallel wires and cables. The electrical switches in the production area shall be transformed for explosion proof.

The project needs to be added with spare supply used for safety detection equipment and exhaust equipment to make sure that the detection and exhaust system can normally run in case of outage or mains failure.

5.2.3 Foaming equipment and safety facility

Minea Electrical Appliance Co., Ltd will purchase a unit of cyclopentane high pressure foaming machine and add some safety facilities.

5.2.3.1 Cyclopentane high pressure foaming machine

The physical characteristics of cyclopentane determine that the high pressure foaming machine features very high specificity and technicality, which shall be integrally designed in an open way for purpose of easy maintenance.

A high pressure foaming machine consists of:

a) ≥330L jacketed ISO and POL+C5 storage tank. The POL+C5 tank must be provided with safety box made of polycarbonate material anti-static electricity and provided with mixer with magnetic coupling. The ISO storage tank is provided with IP54 mixer, with 5-point safety protection, magnetic color marking liquid level display, and with self-cleaning filter.

b) Provided with variable plunger pump ceramic isolating magnetic coupling

c) ≥10 inches display, setting and control touch screen, operating system in Chinese interface.

d) Self-cleaning injection gun. The hydraulic oil tank is ≥100L and the safety air reservoir≥10L. The hydraulic oil tank is provided with temperature monitor and control and heat exchanger.

e) Gun traveling system.

f) It is provide with 5P water chiller and heat exchanger to regulate and ensure foaming temperature, with 2 safety detector, and with extraction and exhaust air system containing air capacity detection.

Formulated polyols with premixed cyclopentane storage tank is sealed with nitrogen so that the carbon hydrogen foaming agent will not directly be in contact with air (oxygen) for purpose of safety of production. For nitrogen, the nitrogen cylinders shall be purchased from the air separation enterprises.

5.2.3.2 Safety alarm system

Constant emission of gaseous cyclopentane is true. Therefore, it is necessary to provide with monitor and alarm device where possibly emission occurs. Control for production of safety while alarming. The alarm system shall consist of:

a) One unit of control cabinet (the control system is designed with relay)

b) One set of safety control apparatus;

c) Gaseous pentamethylene concentration monitoring system (including 8 detectors);

d) One set of formulated polyols with premixed cyclopentane storage tank drip pan and monitoring device;

e) Emergency button;

f) Fire resisting damper;

g) Fire resisting detector;

h) Emergency lighting system;

i) Power supply management (excluding spare power supply)

j) Door status management (ensuring the door within specified area is NC)

k) Remote monitor and control (provided in security guard, respectively displaying the alarm status of three control cabinets)

The safety system alarm function mainly includes:

a) Manual emergency stop alarm

b) Cyclopentane gas detector and secondary instrument fault alarm. It sends alarm when the CP gas concentration reaches 20%LEL and 40%LEL by stages.

c) Minimum nitrogen pressure alarm

d) Air velocity damper alarm of ventilation system

e) Motor fault alarm of ventilation system

f) The alarm system can identify fault risk level, controlled by stage. It may effectively control depending on various risk levels. The primary alarm signal sends audible/visual alarm and the secondary alarm signal shuts off the mains and sends audible/visual alarm.

5.2.3.3 Safety Exhaust System

An air duct for the formulated polyols with premixed cyclopentane warehouse extending out roof of the building will be constructed. An air duct for the formulated polyols with premixed cyclopentane storage tank safety box extending out roof of the building will be constructed. An underground air duct is laid in the foaming working area. One air duct extending out roof of the building is constructed on both sides respectively. The fans are provided on the top of the air duct. The fans are one duty and one spare and the air capacity is regulated step by step.

The ventilation system is mainly set up in the high pressure foaming machine and injecting material foaming site. The fans are one duty and one spare and the air capacity is regulated step by step and start step by step depending on CP gas concentration.

Release CP gas concentration to the external environment through the ventilation system and ensure its concentration away from the explosive limit meanwhile.

5.2.3.4 Fire fighting system

The existing plant is provided with concrete pillar with steel structure beam, with color steel roof. For this project, 162m^2 partition solid wall will be constructed for isolation of foaming working area and the stamping workshop as well as one formulated polyols with premixed cyclopentane warehouse. The foaming working area and PPCP warehouse will be transformed as fire resistant Grade II. On the ground and wall of the formulated polyols with premixed cyclopentane warehouse and foaming working area is treated in anti-static electricity and fire proof way. Fire fighting and extinguishing system is provided near the formulated polyols with premixed cyclopentane warehouse and foaming working area and the combustible gas detection and alarm system will be established in the warehouse and foaming working area. It is provided with 3 units of portable fire extinguishers and 15 hand-held fire extinguishers.

Implementation of fire fighting system shall be verified or accepted by the fire authority.

Table 13 Itemization for Safety Facilities of Minea Project

No.	Device	Q'ty	Device to be installed	Remarks
1	Cyclopentane high pressure foaming machine	1	▲ Foaming production line	
2	Gaseous cyclopentane detector	8	▲ High pressure foaming machine （2） ▲ Foaming production line（4） ▲ Formulated polyols with premixed cyclopentane warehouse (2)	

3	Air duct	3	▲ Formulated polyols with premixed cyclopentane warehouse (1) ▲ High pressure foaming machine polyether safety box (1) ▲ Foaming working area (1)	The air duct within foaming area is provided with an underground air duct as well as both air ducts respectively provided both sides underground air duct extending out the roof.

5.3 Specification of Safe Operation for formulated polyols with premixed cyclopentane

The polyurethane foaming production enterprises using formulated polyols with premixed cyclopentane are always small-scale enterprise with weak technical strength. These enterprises cannot meet the safety requirements of pentamethylene foaming only through transformation of hardware. Their personnel need to be trained for safety awareness and safety of production is standardized through improved management system.

Minea needs to improve relevant management system for Minea project phasing out HCFC-141b:

a) Training and education to staff on safety

b) Establish management regulations for loading / unloading and storage of formulated polyols with premixed cyclopentane

c) Cyclopentane foaming production line SOP

d) Cyclopentane foaming production line safety facilities maintenance and repair SOP

e) Emergency response plan

6 Conclusions

(1) The key technology of premixed cyclopentane and formulated polyols is to solve the compatibility between cyclopentane and polyether; through the sampling investigation of 16

grades' formulated polyols from 6 manufacturers, the results showing that the current domestic polyether suppliers have basically solve the compatibility issue in terms of technology.

(2) Conduct flash point and vapor pressure test on the samples and the results show with the increasing cyclopentane proportion, the hazard of formulated polyols with premixed cyclopentane significantly enhances, proposing higher demand on security measures in the production application process.

(3) Formulated polyols with premixed cyclopentane is Class II flammable liquid according to relevant national regulations.

(4) According to the safety assessment, the demonstration project is proposed to add the relevant security facilities shown in table -12。The conversion plan of Wanhua Rongwei is in line with the relevant safety standards and codes, being able to prevent and control various conditions in production process.

(5) Formulated polyols with premixed cyclopentane may safely be transported in a short and medium distance when strictly following relevant regulations of dangerous chemicals transportation.

(6) The conversion plan of Minea Electrical Appliance Co., Ltd will meet the requirements of cyclopentane foaming. However, trainings shall be conducted to the personnel to raise awareness on safety and help them handling the materials properly. The management system concerning safety production shall be strengthened.

Annex II

Revised agreed conditions for the phase-out of methyl bromide in Mexico

1. The Executive Committee:

   (a) At its 42nd Meeting, approved US $1,105,000 as the total funds that will be available to Mexico in order to achieve the 2005 allowable level of methyl bromide consumption (phase-out of 162.4 ODP tonnes);

   (b) At its 54th Meeting, approved in principle an additional US $9,222,379, as the total funds that will be available to Mexico to achieve the complete phase-out of controlled uses of methyl bromide in soil and commodities fumigation (895 ODP tonnes);

   (c) At its 63rd Meeting, noted the return by the Government of Canada of US $500,000 plus agency support costs of US$58,527, representing the total funds approved for the second tranche of the phase-out of methyl bromide in commodities, and approved US $500,000 plus US $37,500 in agency support for UNIDO for the implementation of this same tranche; and

   (d) At its 63rd Meeting, approved also the request by the Government of Mexico to transfer US $417,522 excluding agency support costs associated with the 2012 and 2013 work programmes for the phase-out of methyl bromide in commodities to be implemented by the Government of Canada to UNIDO.

2. As reported to the Ozone Secretariat, the methyl bromide baseline for compliance for Mexico is 1,130.8 ODP tonnes; the 2009 methyl bromide consumption was 745.4 ODP tonnes. Accordingly, Mexico has achieved compliance with the Montreal Protocol's 2002 freeze obligation and is in compliance with the Protocol's 20 per cent reduction in 2005.

3. Reductions in accordance with the terms of the above-mentioned projects and other commitments presented in the project document will ensure that Mexico meets the reduction schedule presented below. In this regard, Mexico will reduce the national consumption of controlled uses of methyl bromide, excluding quarantine and pre-shipment applications, to no more than the following levels of consumption in the years listed below:

Year	Annual phase-out (ODP tonnes)	Allowable consumption (ODP tonnes)
2008	0	895
2009	100	795
2010	120	675
2011	150	525
2012	200	325
2013	325	

3. Mexico commits to permanently sustaining the consumption levels indicated above through the use of import quotas and other policies it may deem necessary.

4. Funding for the projects will be disbursed by UNIDO and the Governments of Canada, Italy and Spain and with the following yearly budget breakdown:

5. The Government of Mexico has reviewed the consumption data identified in all sectors covered by the project and is confident that it is correct. Accordingly, the Government is entering into this agreement with the Executive Committee on the understanding that, in case any additional methyl bromide consumption is identified at a later date, the responsibility to ensure its phase-out will lie solely with the Government of Mexico.

Year	Soil fumigation			Commodities	Total funding (US$)
	UNIDO (US$)	Italy (US$)	Spain (US$)	Canada/UNIDO (US$)	
2008	2,000,000	1,000,000		500,000	3,500,000
2010	2,000,000		800,000	500,000*	3,300,000
2012	1,000,000		800,000	200,000*	2,000,000
2013	204,857			217,522*	422,379
Total	5,204,857	1,000,000	1,600,000	1,417,522	9,222,379

(*) To be implemented by UNIDO

6. The Government of Mexico, in agreement with UNIDO and the Governments of Canada, Italy and Spain, will have flexibility in organizing and implementing the project's components that it deems more important in order to meet the methyl bromide phase-out commitments noted above. UNIDO, and the Governments of Canada, Italy and Spain agree to manage the funding for the project in a manner designed to ensure the achievement of the specific MB reductions agreed upon.

7. UNIDO shall report annually to the Executive Committee on the progress achieved in meeting the methyl bromide reductions required in all sectors, as well as on annual costs related to the use of the alternative technologies selected and the inputs purchased with the project funds.

9. These revised agreed conditions supersede those reached between the Government of Mexico and the Executive Committee at the 54th Meeting of the Executive Committee.
