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执行蒙特利尔议定书
多边基金执行委员会
第六十三次会议
2011 年 4 月 4 日至 8 日，蒙特利尔

# 关于附有具体报告规定的核定项目执行情况的报告

## 导言

1. 加拿大和日本政府以及开发计划署、环境规划署、工发组织和世界银行已经提交了关于以下项目执行情况的进度报告，各协定中载有其具体报告的规定，以供执行委员会第六十三次会议审议：

(a) 巴西：国家氟氯化碳淘汰计划：2009 年消费量核查及 2010 年进度报告（开发计划署）；

(b) 中国：哈龙生产和消费淘汰方案：关于氟虫腈生产过程中 halon-1301 尾气排放情况的调查报告（世界银行）；

(c) 中国：广东万华容威聚氨酯有限公司在制造硬质聚胺脂泡沫塑料时由使用 HCFC -141b 的预混多元醇到使用环戊烷的预混多元醇的转用示范报告（世界银行）；

(d) 中国：制冷维修行业氟氯化碳淘汰计划执行情况的报告（工发组织）；

(e) 哥斯达黎加：全部淘汰用作瓜类、鲜切花、香蕉、烟草苗床和园艺苗圃熏蒸剂的甲基溴（不包括检疫和装运前消毒处理用途）项目执行情况的进度报告（开发计划署）；

(f) 墨西哥：国家甲基溴淘汰计划（项目的移交）（工发组织）；

(g) 巴拉圭：附件 A 第一类物质最终淘汰管理计划：2008-2010 年执行情况报告（环境规划署）；以及

(h) 斯里兰卡：使用国家履约行动计划下剩余预算的提案（日本）。

2. 秘书处参照原始项目提案、有关国家根据《蒙特利尔议定书》第 7 条报告的消耗臭氧层物质数据以及执行委员会和缔约方会议的有关决定审查了以上所列项目的进度报告、移交项目的申请和使用剩余预算的提案。

## 巴西：国家氟氯化碳淘汰计划：2009 年消费量核查及 2010 年进度报告（开发计划署）

3. 执行委员会第三十七次会议核准了在 2010 年 1 月 1 日之前完全淘汰巴西氟氯化碳消费的国家氟氯化碳淘汰计划，原则上核准的供资金额为 26,700,000 美元。执行委员会第五十九次会议核准了第八次，亦即最后一次付款，同时第 59/40 号决定要求，开发计划署在委员会未来会议商定关于剩余资金相关行动的执行计划之前，不得在执行核准行动之后即行支付已核准的第八次付款的供资或任何剩余供资。开发计划署就第八次付款问题向第六十次会议提供了一项执行计划，而且执行委员会通过第 60/8 号决定注意到了 2008 年核查报告和 2009 年巴西国家淘汰计划年度执行报告，核准了 2010 年和 2011 年年度执行方案，并要求巴西政府在开发计划署的协助下向每年的执行委员会第一次会议提交上一年度的执行报告，直至完成国家淘汰计划。开发计划署向第六十三次会议提交了 2009 年消费量核查及 2010 年进度报告，以及 2011 年度执行计划。

进度报告

4. 进度报告提供信息，介绍了支助巴西减少其氟氯化碳消费量的各项活动。尽管《蒙特利尔议定书》的淘汰时间表允许 2009 年消费 1,578 ODP 吨的氟氯化碳，但巴西政府和执行委员会之间的协定将该国 2009 年的氟氯化碳消费量限定为仅 74 吨。开发计划署报告，该国 2009 年仅消费了 46.9 ODP 吨。2010 年的巴西消费量数字未纳入进度报告。

5. 进度报告提供了有关 2010 年所采取多种行动的详细信息。已收到 3,000 套氟氯化碳回收设备，供制冷技师使用，其中的 150 套已经分发。1 个回收中心已经启用，但因有待地方政府批准，所以尚未投入商业化运营。计划中的 5 个被污染或不纯净各类氟氯化碳储存中心已经建立了 4 个。

6. 进度报告还提供了 CFC-12 和 HCFC-22 回收及再利用数量的相关数据。在巴西，回收、再循环或再利用氟氯化碳的数量是通过三种不同的报告制度上报的：再循环中心的氟氯化碳回收活动、再利用中心活动以及汽车空调的回收和再循环活动。

(a) 再循环中心相关回收活动的数据显示，2006 年至 2010 年间共回收了 35.8 吨 CFC-12 和 62 吨 HCFC-22，其中有 1.1 吨 CFC-12 和 5.6 吨 HCFC-22 已交付再利用。这些数字表明，2009 年的数量显然最多；2009 年之后，中止了捐赠的回收设备的报告要求，从而导致其数据变得不可靠且无法与前几年作出比较。2009 年的数字显示，当年再循环中心的相关技师回收了 27 吨 CFC-12 和超过 37 吨的 HCFC-22；

(b) 再利用中心处理了 47.8 吨 CFC-12 和 57.1 吨 HCFC-22。自 2007 年起，CFC-12 的数量持续减少，降至了 2010 年的 4.8 吨，而 HCFC-22 的数量似乎有所增加，2010 年已处理制冷剂增加至了 16.9 吨；

(c) 还提供了汽车空调方面回收和再循环活动的情况，2007 年及之前分发的 335 套设备于当年处理了 16.5 吨 CFC-12。2008 年及之前分发的 360 套设备于 2008 年处理了 12.2 吨 CFC-12，2009 年的处理量与其大致相等，2010 年的处理量有可能更高；2009 年和 2010 年数量的不确定与设备捐赠条件所规定的报告义务减少有关。

7. 2010 年行动计划预计将对公共机构所有的三台使用氟氯化碳的离心式冷风机加以改造和/或更换。目前，确认合适的场所和雇用顾问人员的工作仍在进行中。在其他行业，涉及泡沫塑料、溶剂、消毒剂和商业制冷剂的投资活动已于 2010 年之前完成。

8. 2010 年还开展了一些非投资活动。目前，针对氟氯化碳制冷设备中小型企业用户的商业制冷剂行业环境管理相关活动正在为此项工作确定合适的顾问。在另一项活动中，已经举办过一期关于“在制冷和空调系统中推广使用替代性液体”的技术讲习班。已经进一步制定并公布尤其是有关氨制冷、制冷剂排放以及回收、再循环和再利用程序的技术标准。也已实施旨在加强遏制消耗臭氧层物质非法交易能力的一些活动。最后，根据计量吸入器过渡战略，还举办了一期国家讲习班。已发布了一篇有关这次研讨会的文章，还制作了一部“从使用氟氯化碳的计量吸入器过渡到无氟氯化碳的药物治疗”的纪录片，供家庭医疗队培训课使用。

9. 通过核查 2009 年 46.86 ODP 吨的氟氯化碳消费量，关于巴西 2009 年消耗臭氧层物质消费量的核查报告证实了巴西向臭氧秘书处提供的第 7 条消费量数据。核查报告满足了各项要求，并证明巴西履行了巴西政府和执行委员会之间关于 2009 年氟氯化碳淘汰协定的各项要求。

2011 年度执行计划

10. 2011 年需完成一系列活动，以最终确定国家淘汰计划。2011 年度执行计划预计分发 2,850 套工具供制冷技师使用，500 套回收设备和 500 套工具供回收和再利用中心使用。还计划举办回收、再循环和再利用问题区域讲习班。将在公司内部建立 125 个再循环中心。关于汽车空调行业的回收和再循环，仅有行业最终评价尚未完成。

11. 2011 年还计划更换或改造三台离心式冷水机，这在最初是打算及早实施的。计划开展四项改造或更换中小型商业制冷设备的试点活动，以建立示范材料，让业主和公众了解改造此类制冷系统的可能性。最后，还将举办关于“在制冷中推广使用替代性液体”的第二期讲习班。该项目还将继续前些年的做法，推动适用标准的制定。将进一步加强包括进口、出口和销售在内的处理消耗臭氧层物质的联邦技术登记做法。最后，还将广泛分发有关从氟氯化碳计量吸入器过渡到替代技术的既有文件，并出版一本小册子。

秘书处的建议

12. 秘书处建议执行委员会：

(a) 注意到 2009 年核查报告和 2010 年巴西氟氯化碳淘汰国家计划的年度执行报告；

(b) 核准 2011 年年度执行计划；并

(c) 请巴西政府在牵头执行机构开发计划署的协助下，继续向执行委员会每年的第一次会议提交上一年度的执行报告，直至完成国家淘汰计划。

**中国：哈龙生产和消费淘汰方案：关于氟虫腈生产过程中哈龙 1301 尾气排放情况的调查报告（世界银行）**

13. 在审查中国原料用哈龙 1301 尾气排放技术稽核情况的背景下，执行委员会在其第五十九次会议的第 59/8（b）（三）号决定中要求中国政府和世界银行：

“a. 迅速开展一项技术研究，以确定因不使用焚烧系统生产氟虫腈所造成尾气排放的哈龙 1301 的数量；

b. 查明有利于环境和经济的措施，以解决此类尾气排放；

c. 就此向执行委员会第六十二次会议提交报告。”

14. 中华人民共和国政府已经通过世界银行提交了“关于中国生产氟虫腈过程中哈龙 1301 尾气排放情况的调查报告”。该报告可应要求提供。

15. 该报告指出，以哈龙 1301 为原料的国内使用量正在增长。2009 年的消费量为 491 公吨。使用哈龙 1301 作为氟虫腈生产原料的企业有 8 家。使用哈龙 1301 作为原料的单位消费量大大高于理论值。其中 1 家企业使用一种焚化装置处理尾气，能够清除哈龙 1301 的排放。其余 7 家企业中有 6 家使用了第 1 类技术即气液固三相反应系统，而第 2 和第 3 类技术是气液两相反应系统。有 1 家企业使用第 2 类技术，1 家企业使用第 3 类技术。第 1 类技术中每生产 1 吨氟虫腈的哈龙 1301 单位消费量从 1.03 吨到 1.32 吨不等。有 1 家企业使用第 2 类技术，1 家企业从第 1 类技术转用第 3 类技术。第 2 类和第 3 类技术每生产 1 吨氟虫腈的单位消费量分别为 0.57 吨和 1.31 吨。该报告指出，可以采取 10 项措施，减少以下方面的哈龙 1301 单位消费量：给料过程；反应过程；包括缓冲回收和溶剂吸附回收系统在内的后处理过程；以及再循环使用。建议使用第 1 类技术的所有企业采取的第 6 项措施是，使用压缩机从反应器顶部疏散哈龙 1301，将其泵入缓冲罐进行再循环。在使用第 1 类技术的 6 家企业中，有 3 家采取此项措施，3 家未采取此项措施。

16. 已采取以下措施将哈龙 1301 造成的损失降低到最小程度：

(a) 将磁力搅拌系统用于压力反应器，以避免动态密封；

(b) 缓冲罐和吸收塔均以钢材制造，采用压力容器技术标准作为设计依据；

(c) 所使用的全部管道、阀门、法兰和仪器都按照其技术规格和实际工艺条件的要求选择；

(d) 设施布局尽可能紧凑，以减少管道长度和法兰数目。

17. 在采取上述措施后，2009 年和 2010 年哈龙 1301 的年度排放量分别为 3.238 公吨（32.4 ODP 吨）和 6.744 公吨（67.4 ODP 吨）。2010 年排放量增加的原因，是 1 家公司从第 1 类技术转用第 3 类技术。

18. 报告建议中国政府：

(a) 要求采用第 1 类技术但尚未采取第 6 项措施的企业执行使用压缩机从反应器顶部疏散哈龙 1301 的措施，以减少哈龙 1301 的排放；

(b) 要求采用第 2 类和第 3 类技术的企业实施进一步的工艺改造和技术改进，以减少哈龙 1301 的排放；并

(c) 仅向满足以上条件的企业提供哈龙 1301 的采购配额。

秘书处的建议

19. 缔约方第四次会议谈及了原料用消耗臭氧层物质的排放问题，缔约方在该次会议上除其他外决定，“ 1.由于从一项制造过程中不经意地或偶然产生的、由于从未起反应的原料产生的、或由于从使用原料作为加工剂而以残留杂质存在于化学物质内的、或在产品制造或处理过程中排放出的极少数量的控制物质，应视为不在《蒙特利尔议定书》第 1 条第 4 款所载的控制物质的定义之内；2. 促请缔约方采取步骤尽量减少这种物质的排放，所采措施当中应包括避免造成这种排放，利用各种切实的控制技术或工序改良以求减少排放，或

加以密封或销毁”（第 IV/12 号决定）。此项规定并未说明已排放的 67.4 ODP 吨哈龙 1301 是否属于从未起反应的原料中产生的极少数量的控制物质。

20. 在其提交给第五十九次会议的报告中，世界银行指出引入减排的成本可能为每个工厂 200 万美元，年度运营费用可能为 1,000 万美元。未使用焚烧系统的工厂根据其与业界合作的专家意见采取了其他措施。世界银行指出，鉴于这是一项原料应用并要求各公司自行实施改造，所以尚未获得有关旨在减少哈龙 1301 排放的已采取措施的实际成本信息。

21. 世界银行还指出，中国政府可能既未出台法律文书也未出台法令来强制执行审计员就此主题提出的建议。世界银行澄清说，中华人民共和国国务院颁发的消耗臭氧层物质条例便于国家环境保护部对控制措施要求采取更有力的立场，如对用作原料的哈龙 1301 的措施要求。根据这一国务院消耗臭氧层物质条例，国家环境保护部有指导各省和地方环境保护局开展执法和监督的任务。

22. 世界银行在同一份报告中还指出氟虫腈是一种有毒物质，中国政府关切其使用的增多可能导致其他环境问题，如水污染。秘书处询问，中国政府是否已在这方面采取了任何行动。世界银行指出，负责规范和核准杀虫剂的农业部确实就有可能造成水污染风险的氟虫腈的使用制定了限制规定。不过，仍有一些获得允许的应用，并且生产商希望继续增加对氟虫腈及其使用的需求。

23. 中国政府审查了该报告，并同意报告中的所有提议和建议。

24. 关于向尚未执行第 6 条措施的企业提出的执行建议，中国政府已通知各公司，包括第 6 条措施在内的所有措施均应尽快执行，且不得迟于 2011 年 12 月。各公司应在所有措施执行完毕后向国家环境部反馈情况，国家环境部将通过实地考察确认本报告建议措施的执行情况。如果未在最后期限前执行，相关公司将无法取得 2012 年哈龙 1301 的采购许可证。

25. 关于采用第 2 类和第 3 类技术的企业应作进一步的工艺改造和技术改进以减少哈龙 1301 排放的建议，国家环境部将通过地方环保局监督减少排放量的进展情况。2012 年哈龙 1301 采购配额的发放将基于届时已实现的减排量。

秘书处的建议

26. 秘书处建议执行委员会要求中国政府和世界银行在未来的年度技术审计报告中继续向基金秘书处报告因不使用焚烧系统生产氟虫腈所造成尾气排放的哈龙 1301 的数量。

**中国：广东万华容威聚氨酯有限公司在制造硬质聚胺脂泡沫塑料时由使用 HCFC-141b 的预混多元醇到使用环戊烷的预混多元醇的转用示范报告（世界银行）**

27. 世界银行就此项目代表中国政府向执行委员会第六十三次会议提交了一份安全性和技术可行性分析报告，旨在示范广东万华容威聚氨酯有限公司在制造硬质聚胺脂泡沫塑料时由使用 HCFC-141-b 的预混多元醇到使用环戊烷的预混多元醇的转用情况。该报告载于本文件附件一。

*背景*

28. 此项目在第五十九次会议上获得批准，费用总额共计 1,214,936，外加给世界银行的 91,120 美元的机构支助费用，但附有一项谅解，即项目第二阶段为美元 635,275 美元的供资须等到第一阶段经过成功验证，并由世界银行向基金秘书处提交相关报告证实大规模示范项目的技术可行性和安全性之后，才由世界银行发放（第 59/31(a)号决定）。

29. 此项目旨在示范环戊烷与多元醇预混的可行性、向泡沫塑料制造商供应预混多元醇的情况，并测试 4 家泡沫塑料制造企业的方法。第一个阶段包括安装 1 个 35 立方米的地下环戊烷槽、2 台预混机、钢桶包装系统、缓冲罐和安全措施。第二阶段包括更新 4 家企业的泡沫塑料机，并引入安全措施。所申请的运营费用为期一年。

*安全性和技术可行性分析报告综述*

30. 特别是在关键技术问题即环戊烷和聚醚的兼容性方面，对转用环戊烷的技术可行性评估进行了考量。需要一种改良的聚醚结构和适用的泡沫塑料稳定剂用于一个稳定和均匀的系统。对于来自包括万华容威在内的 6 家生产商的 16 种代表性等级的干式配方预混多元醇的样本稳定性，在-5°C 至+25°C 的温度范围内进行了测试。进行稳定性测试的江苏省产品质量监督检验研究院发现，所测试的多元醇大多稳定性良好，且能与环戊烷良好兼容。这些结果表明，国内聚醚供应商已经解决了环戊烷和聚醚的兼容问题。

31. 评估的另一项关键内容是混合物的可燃性，因为它设定了运输要求及在公司内部的存储和使用要求。进行了燃点测试，以评估 16 种预混配方多元醇和环戊烷的安全隐患，并将其列入已知隐患类别。已进行的测试证明，按配方制造的多元醇可划分为第二类可燃液体。按配方制造的多元醇和预混环戊烷可作中、短途运输，但前提是它们满足危险货物特别运输条例的要求。

32. 根据对包括生产方法在内的万华容威转用执行情况的评估，提出了进一步加大安全性的建议（1 个环戊烷气体检测与监控系统设备和 1 个水库）。一旦这一新增设备安装完毕（定于 2011 年 3 月完成），万华容威将符合相关的安全性标准及规范。

33. 作为万华容威 4 家下游企业之一的美尼电器有限公司可以通过改造来满足环戊烷发泡要求，具体方法是按照消防局的要求升级生产车间，完善电力供应以确保安全检测设备，并在断电情况下进行排气通风。由于全体员工没有任何可燃物质相关经验，因此必须对其进行安全问题及材料正确处置的培训。

<u>秘书处的建议</u>

34. 秘书处向世界银行提出了几个技术性问题，涉及有必要证明全配方使用碳氢化合物的多元醇系统在 6 个月期限内及为稳定性测试选择的温度范围内的稳定性，鉴于示范项目可能用于其他第 5 条国家，这一温度范围并不能全面代表中国和其他国家的温度范围。世界银行指出，可以进行额外测试，以评价在项目后续阶段达到 35°C 这一的温度的影响。中国并不存在测试预混多元醇稳定性的特定标准。不过，关于任何种类混合材料稳定性的行业惯例通常是 6 个月。此前进行测试的大学曾在室温下将样本保存了 6 个月。其稳定性已被验证。

35. 另外还指出，应该评估有可能向下游企业提供的全配方使用碳氢化合物的多元醇在配方多元醇运输（从系统所在地向泡沫塑料企业）期间以及在企业一级现有条件下的使用安全性，确认其相关缓解措施及其预期相关费用。世界银行答复说，已经对一些意外事故进行了评价，并考虑到了高环境温度的可能性（即运输和装卸期间的事故；碳氢化合物桶暴露于泡沫塑料车间的火灾中；在车间搬运碳氢化合物桶造成的泄漏；以及管道系统和发泡装置中的碳氢化合物泄漏）。已经制定了相应的安全准则。一旦多元醇供应商和下游第一手用户完成安装，就将报告安全措施的费用计算情况。同时针对多元醇供应商和泡沫塑料公司的具体安全要求将由各省消防局规定。由于消防局提出的要求是强制性的，项目将予遵照执行。鉴于费用问题对于下游用户（即较小规模的泡沫塑料公司）至关重要，后续报告将提供已发生的实际安全费用。第一阶段的系统所在地示范项目计划在 2011 年 5 月底之前完成，项目报告将于 2011 年 6 月编制。

36. 秘书处还寻求确认，通过对来自 6 家生产商的 16 种等级配方多元醇进行取样，是否已经解决了在工业化规模上将环戊烷预混进多元醇以便向下游泡沫制造商用户分发供其使用的所有相关技术问题。世界银行答复说，由于环戊烷在预混多元醇中的比例幅度有限（10%至 12%），这 16 种等级可以反应一部分情况。尚不清楚是否已在工业化规模上解决了所有预混技术问题，不过，主要技术问题已经解决，显示出工业化规模生产和全配方使用碳氢化合物的多元醇的使用具有可行性。关于秘书处的关切，即报告并未提供所有必要数据，以精确确定以何种代价制造并分发全配方使用碳氢化合物的多元醇及其是否具有经济合理性或可行性（既在系统所在地一级，也在终端用户一级），世界银行答复说，它将在确认针对公司和实际应用的包括使用碳氢化合物的预混多元醇在内的全系统交付之后提交相关报告。世界银行还指出，其项目第二阶段供资的发放取决于第一阶段的成功验证，以及提交相关报告证实大规模示范项目的技术可行性和安全性，而非第一阶段成功执行的情况。已提交的报告解决了旨在示范成功验证（兼容性）、保质期和运输安全要求的关键活动。世界银行进一步指出，报告还按照《中国消防标准》提供了针对泡沫塑料系统所在地和终端用户的安全计划。基于这些结果得出的结论是，这一碳氢化合物预混多元醇选项具有技术可行性。报告确认，现有条例足以解决供应链不同阶段和终端应用中的各种风险。因此，这份报告所提出的措施可以确保碳氢化合物处理过程中的同一安全水平。

37. 在第五十九次会议上讨论项目提案期间，秘书处提出了一个关于传播示范项目成果的问题。世界银行指出，泡沫塑料行业充分了解现有的各项活动，已与中国的其他两个主要系统讨论了技术报告，这两个系统都认为预混碳氢化合物多元醇是一个可行的选择，而且已经组织了两次研讨会，与业界讨论了该报告。

<u>秘书处的建议</u>

38. 谨请执行委员会：

(a) 注意到世界银行提交的关于项目安全性和技术可行性分析的报告，该报告旨在示范广东万华容威聚氨酯有限公司在制造硬质聚胺脂泡沫塑料时由使用 HCFC-141b 的预混多元醇到使用环戊烷的预混多元醇的转用情况；

(b) 授权世界银行向中国支付项目第二阶段的资金 635,275 美元；

(c) 请世界银行提交包括安全措施费用计算在内的项目第一阶段的报告，以供执行委员会第六十五次会议审议。

**中国：制冷维修行业氟氯化碳淘汰计划执行情况的进度报告（工发组织）**

39. 工发组织作为牵头执行机构，代表中国政府向执行委员会第六十三次会议提交了关于实施“中国制冷维修行业氟氯化碳淘汰计划”（维修行业计划）的进度报告。工发组织向第六十二次会议提交了 2009 年行业消费量的核查报告。在第 62/7 号决定中，执行委员会注意到了 2009 年中国维修行业氟氯化碳消费量的核查报告，也注意到将在执行委员会第六十三次会议上审议 2009 年和 2010 年的执行报告。

背景

40. 维修行业计划是在执行委员会第四十四次会议上核准的，其中工发组织作为牵头执行机构，日本作为合作双边机构。原则上为该计划批准的供资总额为 7,885,000 美元，外加 836,130 美元机构支助费用。第四十五次会议对协定进行了修订，增加环境规划署为合作执行机构。维修行业计划旨在支持中国履行其根据《蒙特利尔议定书》承担的义务，包括在 2010 年前完全淘汰用于受控用途的各类氟氯化碳。为了实现这些目标，中国在各个机构的援助下实施了一系列投资、非投资技术援助和能力建设活动。该行业计划的最后一次付款在执行委员会第五十九次会议上获得核准。

41. 提交第六十二次会议的核查报告确认了维修行业 398.56 ODP 吨的消费量，较中国和执行委员会达成的 2009 年协定中规定的限值低 7.4 ODP 吨。

2010 年年度执行情况报告

42. 2010 年执行的活动大致与三种减少和消除对各类氟氯化碳的依赖的方法有关。这些方法包括宣传活动、政策发展和研究以及回收和再循环，重点是含有氟氯化碳的制冷和空调设备的报废处理。下文简要概括了取得的成就：

(a) 通过出版材料和在中国臭氧行动时事通讯中定期报告针对有关利益方和技术人员的维修行业计划，向技师、企业和公众宣传提供信息；此外，在全国范围内向公众宣传氟氯化碳的回收、再循环和再生；

(b) 中国政府开展的政策活动包括采取措施，促进氟氯化碳收集和回收利用系统的建立，以及制定法规，限制制冷设备维修和报废设备处置过程中氟氯化碳的排放和释放；

(c) 在汽车空调行业中，对 6,067 名技师进行了培训，410 个汽车空调维修站和汽车处置站正在负责收集汽车空调。二十八个家用电器拆卸站总共配备有 200 个用于移除报废家电中的各类氟氯化碳的设备，并配备有接受过必要培训的人员。与工业和商业制冷设备的维修相关的八十家企业和培训中心正在接收回收和再循环设备。中国也确定了 50 个船舶拆卸站，但还不具备回收消耗臭氧层物质的技术能力。目前正在准备为船厂提供回收设备；以及

(d) 2010 年执行的活动也包括监督、核查和方案管理以及总体监督，以确保遵守维修行业的消费限额。

2011 年年度执行方案

43. 2011 年的年度执行方案预计将继续开展并结束已经在 2010 年执行情况报告中报告的活动。

秘书处的评论

44. 秘书处注意到维修行业计划的执行取得了良好进展，以及 2011 年的活动相对有限，这使得项目可能在 2011 年结束。秘书处也注意到各个行业在从报废设备中收集各类氟氯化碳方面所开展的重要活动，在广义划分方法中，这是氟氯化碳淘汰计划的一个独特的特征。

秘书处的建议

45. 秘书处谨建议执行委员会：

(a) 注意到有关 2010 年中国制冷维修行业淘汰计划执行情况的进度报告；以及

(b) 核准 2011 年的执行方案，但附有一项谅解，即工发组织将在每个历年提供有关开展的活动、花费的资金和剩余预算的报告，直到完成淘汰计划的结账工作。

**哥斯达黎加：全部淘汰用作瓜类、鲜切花、香蕉、烟草苗床和苗圃熏蒸剂的甲基溴（不包括检疫和装运前消毒处理）项目执行情况的进度报告（开发计划署）**

*背景*

46. 工发组织代表哥斯达黎加政府，向第六十三次会议提交了全部淘汰用作瓜类、鲜切花、香蕉、烟草苗床和苗圃熏蒸剂的甲基溴（不包括检疫和装运前消毒处理）项目的第五次付款执行情况的 2010 年年度进度报告。

47. 执行委员会第三十五次会议原则上核准了该项目，连同第一次付款的供资（1,211,321 美元和给开发计划署的机构支助费用 143,245 美元）。第二次和第三次付款在第四十三次会议上核准，第四次付款在第四十九次会议上核准；项目的第五次付款在第五十九次会议上核准，供资总额为 726,791 美元，外加给开发计划署的机构支助费用 54,509 美元。达成了下列开发计划署发放时间表：2009 年发放 363,400 美元；2010 年底发放 255,000 美元；2012 年底发放 108,391 美元；但附有一项谅解，即 2010 年和 2012 年供资的发放条件为开发计划署提交报告，说明已经达到淘汰目标（第 59/36(c)号决定）。第 59/36(d)号决定也请开发计划署提交项目执行情况的年度进度报告，包括财务报告，直到项目完成。

*年度进度报告*

48. 在三个哈密瓜和西瓜农场进行了验收测试，以此作为在哥斯达黎加甲基溴登记要求的一部分。然而，商业公司还未着手办理熏蒸剂登记程序。派遣代表团到洪都拉斯收集了有关生物熏蒸技术的信息，并已将该技术引入到哈密瓜和西瓜的培育过程中作为甲基溴的替

代技术。洪都拉斯代表团也回访了哥斯达黎加的两个农场。因此，哥斯达黎加的最大甲基溴消费者决定采用生物熏蒸技术。2010 年晚些时候与有关当局召开了会议，以确保获得政府支持使生产商持续遵守甲基溴淘汰目标。在核准的总共 4,845,283 美元供资中，已经发放了 4,481,892 美元，剩下的 363,391 美元将在 2011 年（255,000 美元）和 2012 年（108,391 美元）发放。

*将开展的进一步活动*

49. 拟议在 2011 年开展下列活动，预算为 234,650 美元：获得有关从化学品转换为生物制剂方面的技术建议援助；哈密瓜和西瓜生产中的杂草和疾病控制；针对农民实施培训方案，并开展公共宣传/信息分发活动；加强生物控制生产实验室，从而支持农场转向生物控制技术；与政府保持沟通，确保达到商定的 2011 年甲基溴淘汰目标；以及监督哈密瓜和西瓜的收获情况。

秘书处的评论

50. 根据开发计划署提交的进度报告，哥斯达黎加进口了 169.3 ODP 吨甲基溴，低于在第五十九次会议上商定的修订时间表中确定的 170.0 ODP 吨。开发计划署告知，通过官方许可证制度以及 2010 年臭氧机构发布的许可获得了进口数量，并且使用甲基溴的公司已确认该数据准确无误。

51. 在第四十八次会议上，执行委员会请哥斯达黎加政府和开发计划署在将来的所有工作方案中列入瓜类行业加快引入全面替代技术的程序（第 48/16(b)(二)号决定）。开发计划署解释，响应委员会要求的策略是确定替代技术程序的成功范例，并将其适用于哥斯达黎加的项目。开发计划署目前正在使用洪都拉斯引入生物熏蒸技术的成功范例编制一份工作计划，该计划将使哥斯达黎加的最大瓜类和哈密瓜生产商得以在 2012 年淘汰甲基溴的使用。作为该工作计划的一部分，将聘请成功协助洪都拉斯生产商的洪都拉斯专家。

52. 关于碘甲烷的使用，开发计划署解释，不会将重点过多地放在这一替代熏蒸剂的使用上，因为进口公司不愿提供熏蒸剂今后的成本的信息。关于碘甲烷的鉴定，进口商表示由于储存时间过长，鉴定试验中使用的熏蒸剂已经失效。哥斯达黎加将不限制碘甲烷的使用，如果符合要求将支持碘甲烷的登记。尽管如此，进口商必须发挥更加积极的作用，因而目前会将更多重点放在其他替代技术上。

秘书处的建议

53. 谨建议执行委员会：

(a) 注意到哥斯达黎加有关全部淘汰用作瓜类、鲜切花、香蕉、烟草苗床和苗圃熏蒸剂的甲基溴（不包括检疫和装运前消毒处理）的项目执行情况的 2010 年年度进度报告；

(b) 注意到哥斯达黎加 2010 年的甲基溴消费量低于该国经修订的甲基溴淘汰时间表所示的最高消费量；

(c) 核准开发计划署向哥斯达黎加发放 255,000 美元，作为该项目第五次付款的一部分；

(d) 请开发计划署根据第 59/36 号决定提交有关项目执行情况的年度进度报告，包括财务报告，直到项目完成。

**墨西哥：国家甲基溴淘汰计划（项目的移交）（工发组织）**

54. 墨西哥和加拿大政府已同意向工发组织移交与墨西哥国家甲基溴淘汰计划的商品部分有关的供资，不包括目前正由加拿大政府实施（双边合作）的供资的第一次付款。因此，工发组织作为甲基溴淘汰计划的牵头执行机构，向第六十三次会议提交了核准移交 500,000 美元供资和在该次会议上实施第二次付款的机构支助费用的申请；核准加拿大向工发组织移交与 2012 年和 2013 年工作方案（第三次和第四次付款）有关的 417,522 美元（不包括机构支助费用）；并核准考虑到这些行动的经修订的墨西哥淘汰甲基溴议定条件。

55. 关于余额和资金供应情况的报告文件（UNEP/OzL.Pro/ExCom/63/4）述及了退还已核准资金的申请。对 2012 年和 2013 年工作方案议定条件的修订作为附件一附于本文件中。

*背景*

56. 甲基溴淘汰计划是在执行委员会第五十四次会议上核准的，供资总额为 9,222,379 美元，由加拿大、意大利和西班牙政府以及工发组织根据墨西哥政府与执行委员会在该次会议上达成的议定条件执行。供资的第一次付款（3,500,000 美元）和第二次付款（3,300,000 美元）分别在第五十四次会议和第六十次会议上获得核准。

*进度报告*

57. 淘汰计划商品部分的第一次付款将在 2011 年 4 月前实质性完成。供资第二次付款拟用于开展的活动包括技术援助以及磷化氢、硫酰氟和热处理应用设备。总共将淘汰 31.5 ODP 吨甲基溴。

秘书处的评论

58. 秘书处注意到，加拿大政府向工发组织移交供资第二次和随后付款符合在第五十四次会议上商定的条件的附带条件，即不再就墨西哥淘汰用于受控用途的甲基溴向多边基金申请更多供资。

秘书处的建议

59. 谨建议执行委员会：

(a) 核准向工发组织移交 500,000 美元，外加支助费用 37,500 美元，用于执行淘汰墨西哥商品中使用的甲基溴项目的第二次付款。

(b) 核准加拿大政府向工发组织移交与淘汰墨西哥商品中使用的甲基溴的 2012 年和 2013 年工作方案有关的 417,522 美元，不包括机构支助费用；以及

(c) 核准作为附件二附于本文件中的经修订的墨西哥淘汰甲基溴议定条件。

**巴拉圭：附件 A 第一类物质最终淘汰管理计划（2008-2010 年执行情况报告）（开发计划署和环境规划署）**

60. 环境规划署作为附件 A 第一类物质最终淘汰管理计划的牵头执行机构，代表巴拉圭政府向执行委员会第六十三次会议提交了第四次，亦即最后一次付款的进度报告。

*背景*

61. 巴拉圭的最终淘汰管理计划是在执行委员会第五十一次会议上核准的，计划到 2009 年完全淘汰氟氯化碳消费量。执行委员会原则上核准了 565,000 美元的供资总额，外加给开发计划署和环境规划署的机构支助费用 53,045 美元。在同一次会议上，执行委员会核准了第一次付款的供资，随后付款在第五十八次会议（第二次和第三次付款）和第六十次会议（第四次付款）上获得了核准。第六十次会议要求巴拉圭在开发计划署和环境规划署的协助下，在第六十三次会议之前提交有关最终淘汰管理计划第四次，亦即最后一次付款工作方案执行情况的进度报告。

*最终淘汰管理计划第四次付款执行情况的进度报告*

62. 环境秘书处与海关就消耗臭氧层物质进口许可证制度的执行以及防止非法交易签订了一项合作协定。自 2010 年第四季度以来，国家臭氧机构访问了海关的在线系统，以核准消耗臭氧层物质许可证并及时提供进口管制信息。13 位培训人员和 10 位海关官员接受了培训。2010 年 10 月，国家臭氧机构与环境规划署共同组织了一次讲习班，目的是促进协调，以解决包括阿根廷、巴西、智利和乌拉圭在内的邻国之间的非法交易问题。通过与政府和教育机构建立战略性合作关系，宣传制冷行良好做法。制冷技师协会参与编制了工作能力标准，以及培训课程的宣传。

63. 举办了三十次有关良好做法和使用替代技术的技术研讨会，并于 2010 年 6 月购买了另外 450 个工具包，作为奖励分发给制冷技师。总共有 679 名技术人员接受了培训并分发了 635 套培训教材。编制并向受训者分发了 2,000 份有关制冷行业良好做法的海报、1,000 份培训课程宣传册和 1,000 份有关无须改造设备的替代技术的技术说明书。确定了两个认证机构，制度一旦出台，2011 年上半年则将认证 100 位技术人员。将一些要素融入到氟氯烃淘汰管理计划中，用以解决氟氯烃使用和诸如跟踪巴拉圭氟氯烃使用的管理系统的设备的控制和监控问题。

64. 截止 2010 年 12 月，在至今核准的 565,000 美元供资中，已经发放或承付了 441,681 美元，还剩有 123,319 美元的余额。

*2011 年和 2012 年计划开展的活动*

65. 2011 年和 2012 年，剩余的供资将用于完成维持各类氟氯化碳零消费和促进氟氯烃淘汰的活动，包括氟氯烃淘汰管理计划的宣传活动；对培训人员进行设备改型（尤其是天然制冷剂和较低全球升温潜能值替代技术的使用）方面的培训；向技师提供维修工具，以及执行、监督和控制最终淘汰管理计划。2011 年，环境秘书处与巴拉圭海关将继续监控消耗臭氧层物质的进口（氟氯烃和混合物）和替代品（氢氟碳化物及其他），制定销毁设备所含

各类氟氯化碳的战略，加强电子许可证制度的实施，并建立制冷行业的技师认证制度（100名技师）。

秘书处的评论

66. 2009年，巴拉圭报告的氟氯化碳消费量为10.79 ODP吨。2010年的初步数据显示，巴拉圭未进口各类氟氯化碳。最终淘汰管理计划最后一次付款涵盖的活动的重点不仅包括最终淘汰管理计划的各项目标，还包括维持各类氟氯化碳零消费和促进氟氯烃淘汰的活动。

67. 在要求澄清延迟执行认证计划和推迟技师认证的原因时，环境规划署解释，延迟执行的原因是缺乏执行这一程序的国家劳动力认证系统。因此，必须确定和评估若干可能的认证机构。2011年4月，哥伦比亚国家培训服务机构将针对评估人员和审查人员编制有关制冷行业认证的培训课程，针对100名技师的试点认证程序有望在2011年年中之前完成。

68. 关于两家医院使用氟氯化碳的设备的改型工作出现延迟以及对20名技术人员进行培训的问题，环境规划署解释，延迟的原因是面对巴拉圭的高温环境以及所需的制冷需求，国家缺乏提高替代制冷剂效率的能力。由于项目的主要目的是培训20名培训人员以采用具有较低全球升温潜能值的制冷剂，该活动可提供将氟氯化碳淘汰与氟氯烃淘汰联系在一起的唯一机会。实践培训将建立国家在氟氯烃淘汰期间可能实施的将来改型方案方面的能力。目前使用CFC-12技术的系统由CFC-12国家库存提供。

69. 由于最终淘汰管理计划执行的延迟，巴拉圭政府已经估计到各类氟氯化碳的消费量为零（不再生产各类氟氯化碳，因此非法贸易风险减少），以及实现2013年和2015年氟氯烃履约指标的时间有限，秘书处建议最终淘汰管理计划下的剩余可动用资金可用于以下方面的活动：加强许可证和配额制度、控制消耗臭氧层物质（主要是氟氯烃，但也包括各类氟氯化碳）非法贸易，以及为技术人员提供良好维修做法（涉及所有制冷剂）方面的培训并提供工具。环境规划署表示，对建议进行了考虑，认为继续实施信息分发活动并加强防止消耗臭氧层物质非法贸易是可行的。

秘书处的建议

70. 谨建议执行委员会：

(a) 注意到2010年执行期间附件A第一类物质最终淘汰管理计划执行情况的进度报告；以及

(b) 请巴拉圭使用最终淘汰管理计划第二次、第三次和第四次付款的可动用剩余资金来完成剩下的活动，以便维持各类氟氯化碳的零消费并支持促进巴拉圭淘汰氟氯烃的其他活动。

**斯里兰卡：国家履约行动计划（使用剩余资金的提案）（日本）**

71. 日本政府作为国家履约行动计划的牵头执行机构，代表斯里兰卡政府向第六十三次会议提交了使用斯里兰卡国家履约行动下剩余资金的提案。

背景

72. 斯里兰卡的国家履约行动计划在第四十三次会议上核准，以期到 2009 年全部消除各类氟氯化碳和哈龙的消费。核准了 1,015,000 美元的供资总额，外加给日本的机构支助费用 86,502 美元和给环境规划署的机构支助费用 45,448 美元作为单独的一次付款提供。2010 年 12 月底，在核准用于日本正在执行的计划部分的 665,400 美元供资总额中，已经发放了 174,395 美元。

73. 日本正在执行的四个计划部分中的两个，即回收和再循环方案以及汽车空调的回收、再循环和改型方案已经完成，第三部分——监督淘汰计划所包含的各项活动——未出现延迟。第四部分，即针对商业和工业终端用户的激励方案，由于一些原因不能及时完成，这些原因包括申请者未能提供奖金支付的适当文件，2008 年发布禁令之前可以按竞争价格在斯里兰卡市场上购买各类氟氯化碳，并且在 2004 年海啸之后，海滨酒店和度假胜地中使用氟氯化碳的大多数商业制冷系统都已通过政府提供的财务激励措施进行了更换。此外，斯里兰卡政府表明，斯里兰卡北方和东部省份的淘汰活动由于安全问题现在不能够开展或继续进行。

74. 2010 年 9 月日本政府向环境规划署提议，国家履约行动计划的剩余资金可用于提供额外的回收和再生设备及大约 10 个终端用户制冷系统的改型。这些活动将由国家臭氧机构在开发计划署的支助下执行。将与当地的维修技师协会和交易商协调开展培训活动，以便最大程度地扩大外联活动。

秘书处的评论

75. 2008 年和 2009 年，斯里兰卡根据《蒙特利尔议定书》第 7 条报告各类氟氯化碳和哈龙的消费量为零，这表明斯里兰卡已经根据与国家履约行动计划有关的淘汰时间表履行了淘汰消耗臭氧层物质的承诺。秘书处也注意到，使用国家履约行动计划下剩余资金的提案符合第 60/11 号决定的规定，该决定允许将最终淘汰管理计划/国家淘汰计划的供资付款用于维持各类氟氯化碳零消费的活动以及促进氟氯烃淘汰的其他活动。

76. 日本政府提议，剩余资金可移交给氟氯烃淘汰管理计划的牵头执行机构环境规划署，用于支持主要是斯里兰卡北方和东部地区工业和消费者的活动，从而淘汰仍在进行的氟氯化碳使用和淘汰氟氯烃的活动。

77. 在第六十二次会议上，执行委员会核准了斯里兰卡 2010-2020 年期间氟氯烃淘汰管理计划的第一阶段，供资金额为 647,866 美元，将由开发计划署（398,866 美元）和环境规划署（249,000 美元）执行，以便支持维修行业中的氟氯烃淘汰活动、投资项目（制造），以及制冷和空调组装次级行业的技术援助活动。

秘书处的建议

78. 谨建议执行委员会：

(a) 注意到日本政府有关使用斯里兰卡国家履约行动计划下剩余资金的提案的报告；

(b) 核准斯里兰卡政府继续执行国家履约行动计划下核准的淘汰活动，以便维持斯

里兰卡的各类氟氯化碳零消费并支持促进氟氯烃淘汰的其他活动的申请；

(c) 在执行委员会第六十六次会议之前提交国家履约行动计划下各项活动执行情况的最终报告。

**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**

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## 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.<br>▲ Start infusion: send signal to the premixed station to start feeding.<br>▲ Stop feeding: stop feeding when reaching the required amount.<br>▲ 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)<br>▲ Static mixer (1)<br>▲ Intermediate tank (1) | |
| 2 | Safety box | 1 | ▲Static mixer | |
| 3 | Surrounded pool | 2 | ▲Static mixer<br>▲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)<br>▲ 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.

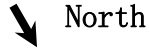
**The basic requirements of Minea Electrical Appliance Co., Ltd can meet the requirements of the demonstrated project phasing out HCFC-141b.**

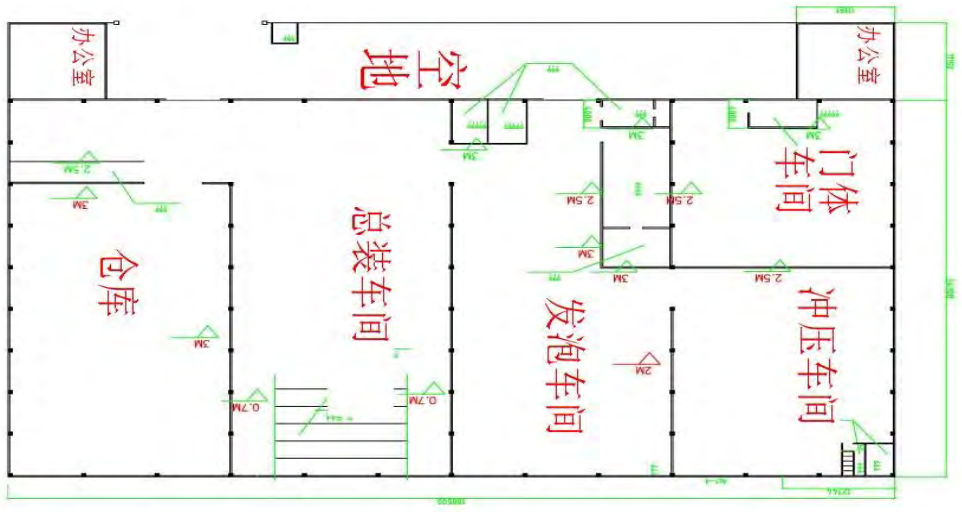
## 5.2 Implementation scheme for formulated polyols with premixed cyclopentane production transformation of Minea Electrical Appliance Co., Ltd

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）<br>▲ Foaming production line（4）<br>▲ Formulated polyols with premixed cyclopentane warehouse (2) | |

| | | | | |
|---|---|---|---|---|
| 3 | Air duct | 3 | ▲ Formulated polyols with premixed cyclopentane warehouse (1)<br>▲ High pressure foaming machine polyether safety box (1)<br>▲ 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.

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# 附件二

## 经修订的墨西哥淘汰甲基溴的议定条件

1. 执行委员会：

(a) 在其第四十二次会议上，核准向墨西哥提供共 1,105,000 美元，用于达到 2005 年甲基溴允许消费量（淘汰 162.4 ODP 吨）；

(b) 在其第五十四次会议上，原则上核准向墨西哥追加共 9,222,379 美元，用于全部淘汰土壤和商品杀虫中用于受控用途的甲基溴（895 ODP 吨）；

(c) 在其第六十三次会议上，注意到加拿大政府退还 500,000 美元和机构支助费用 58,527 美元，这是核准用于淘汰商品中使用的甲基溴的第二次付款的总金额，核准了 500,000 美元和给工发组织用于实施此次付款的机构支付费用 37,500 美元；以及

(d) 在其第六十三次会议上，另外核准了墨西哥政府提出的移交 417,522 美元的资金申请，不包括给工发组织的有关加拿大政府实施的淘汰商品中的甲基溴的 2012 和 2013 年工作方案的机构支助费用。

2. 正如臭氧秘书处所报告，墨西哥的甲基溴履约基准为 1,130.8 ODP 吨；2009 年的甲基溴消费量为 745.4 ODP 吨。因此，墨西哥已经履行了《蒙特利尔议定书》中规定的 2002 年冻结义务，并符合《议定书》2005 年减少 20%消费量的要求。

3. 符合上述项目条款和项目文件中的其他承诺的削减量将确保墨西哥达到下文削减时间表的要求。为此，在下列年份，墨西哥将减少用于受控用途的甲基溴（不包括检疫和装运前消毒处理）的全国消费量至下列消费量之下：

| 年份 | 年度淘汰量（ODP 吨） | 允许消费量（ODP 吨） |
|---|---|---|
| 2008 | 0 | 895 |
| 2009 | 100 | 795 |
| 2010 | 120 | 675 |
| 2011 | 150 | 525 |
| 2012 | 200 | 325 |
| 2013 | 325 | |

4. 墨西哥承诺将通过使用进口配额和其可能认为有必要的其他政策，长期保持上文所示的消费量。

5. 项目供资将由工发组织以及加拿大、意大利和西班牙政府发放，年度预算细目如下：

6. 墨西哥政府审查了项目涉及的所有行业中确定的消费量数据，并确信这些数据准确无误。因此，墨西哥政府将与执行委员会签订该协定，但附有一项谅解，即如果随后确定了其他的甲基溴消费量，确保淘汰甲基溴的职责将由墨西哥政府独自承担。

| 年份 | 土壤杀虫 | | | 商品 | 供资总额（美元） |
|---|---|---|---|---|---|
| | 工发组织(美元) | 意大利（美元） | 西班牙（美元） | 加拿大/工发组织（美元） | |
| 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 |
| 共计 | 5,204,857 | 1,000,000 | 1,600,000 | 1,417,522 | 9,222,379 |

(*)将由工发组织实施

7. 墨西哥政府与工发组织及加拿大、意大利和西班牙政府商定，将灵活组织和实施其认为更加重要的项目的各个部分，以便实现上述甲基溴淘汰承诺。工发组织与加拿大、意大利和西班牙政府同意，以保证实现商定的具体甲基溴削减量的方式，管理项目的供资。

8. 工发组织应每年向执行委员会报告要求所有行业削减甲基溴消费量的实施进度，以及与所选替代技术的使用和使用项目资金购买的投入物资有关的年度成本。

9. 这些经修订的议定条件取代墨西哥政府与执行委员会在执行委员会五十四次会议上达成的条件。

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