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Demonstrating HCFC Alternatives under Local Conditions: update from UNDP

November 2011

After the Montreal Protocol was adjusted in 2007 to accelerate the phase-out of HCFCs, Parties were encouraged to promote the development and the availability of alternatives to HCFCs that minimize environmental impacts, particularly for those specific applications where such alternatives are not presently available and applicable. The decision of the Meeting of Parties to the Montreal Protocol (decision XIX/6, 2007) **encourages Parties to promote the selection of alternatives to hydrochlorofluorocarbons (HCFCs) that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations.**

The Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol (Executive Committee) has agreed on the importance of approving a limited number of projects in Article 5 countries to demonstrate emerging technologies in various industrial processes under local conditions. The Executive Committee has since 2007 approved such demonstration projects in different sectors, mainly foam, refrigeration and air conditioning.

UNDP has been at the forefront of demonstration projects since 1996 and is currently implementing demonstration projects in all regions and all sectors. UNDP is in the process of assessing relatively new technological developments that have not or scarcely been used in developing countries. This task is conducted on behalf of and financed by the Multilateral Fund for the Implementation of the Montreal Protocol (MLF).

For the **Polyurethane** (PU) foam and **Extruded Polystyrene** (XPS) sectors, assessments are being conducted for super-critical CO_2, methylal, optimized hydrocarbon technologies, CO_2 with methyl formate co-blowing and HFO-1234ze. The assessment report on the use of methyl formate has already been completed and considered by the Executive Committee in November 2010. The others are being finalized by latter half of 2011 and early 2012. For the refrigeration and air conditioning (RAC) and solvents sectors, assessment are being conducted for ammonia/CO_2 in the manufacture of two-stage refrigeration systems for cold storage and freezing applications; HFC-32 in the manufacture of commercial air-source chillers/heat pumps; and iso-paraffin and siloxane (KC-6) for cleaning in the manufacture of medical devices.

It is important to note that companies that participate in any MLF funded programs always have full freedom of choice in the technology that is selected.

The update on the status of UNDP demonstration projects in different sectors is provided below.

Polyurethane (PU) Foam

The PU foam market is facing external demand from consumers looking for "greener products" (i.e. blowing agents that are not HCFC-based and with the lowest global warming potential (GWP) possible). In phasing out the HCFCs with high ozone-depleting potential (ODP) in PU sector, it is necessary to consider the size of PU Industry (HCFC consumption) and alternatives with low GWP which are a commercially and technically available within the country for the specific PU applications and their conditions related to the end-users (PU Producers) size, the technology availability, costs and processability.

Pilot projects for assessment of alternative technologies in PU Foam Applications were approved at 59th meeting of the Executive Committee, in July 2009 and have the objective to develop, optimize and assess the use of methyl formate and methylal as blowing agents in PU applications. The activities were conducted in Brazil for 14 applications of PU foams whereas in Mexico only for shoe soles applications. These projects address health, safety, environmental, technical and indicative commercial issues.

The final report on the **Methyl Formate (MF)** demonstration project was presented to the 62nd meeting of the Executive Committee. Some conclusions from the report were that methyl formate can be considered as a suitable alternative for small and medium enterprises (SME) and that is not suitable for domestic refrigeration manufacturing. Demonstrations revealed some issues with flammability, requiring safeguards at system house level - where the MF is handled pure - and special attention must be given in the formulation of the PU-systems. Also, there is the need for acid proofing of equipment at the end user level. Availability of methyl formate depends on the national context and should be carefully analyzed. As a result of such analyze, methyl formate was selected as an alternative technology for approved MLF projects in Egypt, Mexico, Nigeria, Brazil, Jamaica, Trinidad and Tobago, Cameroon, and some others.

The pilot project for the assessment of **Methylal (ML)** in the PU Foam Sector in Brazil and Mexico is being concluded and a final report on the results will be presented to 66th meeting of the Executive Committee. Preliminary foam properties results look promising although there are some issues with flammability, requiring safeguards at system house level - where the ML is handled pure - and special attention must be given in the formulation of the

PU-systems- to obtain non-flammable PU systems or to implement safeguards at the end user level if flammability is accepted. The emission study is being finalized so a comprehensive analysis of health and safety issues is obtained. The project is expected to finish by end of November 2011 and a seminar will follow, to present results for 18 applications in Rigid, Integral Skin and Flexible Foams. The Methylal Seminar will take place in the city of São Paulo, Brazil, December 6-7, 2011.

Low cost options for the use of **Hydrocarbons (HC)** as foaming agents in the manufacture of PU Foam are being considered as part of a demonstration project in Egypt. The project was approved at 58th meeting of the Executive Committee in July 2009. The objective of this project is to develop, optimize, and disseminate low-cost systems for the use of hydrocarbons in the manufacture of PU rigid insulation and integral skin foams.

Photo: foam dispensing equipment that is able to use a premixed Polyol / HC blend along with the option to metering HC as third stream directly into a mixing and pouring head.

Tests were carried out with direct injection and pre-blended polyols. Shelf life tests and mixing head optimization have been performed. Shelf life tests concluded showed satisfactory stability for cyclopentane systems. Further testing on direct injection showed the potential of system reactivity improvement through a slight adjustment in the catalyst package. This might make the mixing head redesign not needed and would close experimental part of the project. The final report is expected to be issued to the 66th ExCom. Both options that are emerging from the project—preblended cyclopentane systems and direct HC injection—have been selected for ODS phase-out projects in Brazil and Egypt.

<u>Extruded Polystyrene (XPS) Foam</u>

Demonstration project for conversion from HCFC-22 / HCFC-142b technology to **CO2 with methyl formate co-blowing technology** in the manufacture of extruded polystyrene foam (XPS) at Feininger (Nanjing, China) was approved at 64th meeting of the Executive Committee in July 2011. The project is planned to be completed by mid-2013.

Piloting of the Validation of the use of **HFO-1234ze** as Blowing Agent in the Manufacture of Extruded Polystyrene Foam Boardstock in Turkey was approved at 60th meeting of the Executive Committee in April 2010. Once completed, the technology is expected to contribute to availability of cost-effective options to implement HCFC phase-out in extruded polystyrene boardstock. Production tests have been done with supplied chemical in February 2011. Technical visits took place for the trials and discussion of results and foam properties. The next round of trials will be arranged in January 2012. An updated interim report will be provided after the trials and foam property tests have been completed in 2012.

Solvents

Jointly with Japan as bilateral donor, UNDP is implementing one demonstration project in China in this sector. The project is to validate the use of so-paraffin and siloxane (KC-6) for cleaning in the manufacture of medical devices. This demonstration project was approved at 64th meeting of the Executive Committee in July 2011 and is expected to be completed by mid-2013.

Air Conditioning and Refrigeration

Several A5 countries need to address HCFC-22 consumption, in addition to HCFC-141b, for compliance with the 2013 and 2015 control targets, due to the significant HCFC-22 consumption in manufacturing in the baseline and also due to the long term impacts in servicing sector consumption, from rapid proliferation in the population of HCFC-22 based air conditioning and refrigeration equipment. Moreover, air conditioning and refrigeration equipment is energy-intensive. Thus, selection of efficient and environment-friendly alternative technologies for HCFC-22, can potentially multiply favorable climate impacts.

UNDP is implementing two demonstration projects with low-GWP alternative technologies for replacing HCFC-22 technology in selected refrigeration and air conditioning applications in China:

- **Ammonia/CO_2** cascade technology in the manufacture of cold storage and freezing systems at Yantai Moon Group
- **R-32** technology in the manufacture of commercial air-source chillers/heat pumps at Tsinghua Tong Fang

Both demonstration projects were approved at the 60th meeting of the Executive Committee and are planned to be completed by mid-2012.

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In addition in June 2011, UNDP facilitated the path-breaking agreement between Indonesia and Japan governments for commercially introducing R-32 technology for room-air conditioners in Indonesia beginning 2015, in cooperation with Panasonic Corporation. This has the potential for market transformation towards low-GWP alternatives in air-conditioners for the first time.

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