Multilateral Fund
for the Implementation of the Montreal Protocol

OBJECTIVE

To establish the suitability of CO_2 with methyl formate (MF) co-blowing technology as a viable replacement of the currently used HCFC-22/HCFC-142b blowing agent in the manufacture of extruded polystyrene (XPS) foam

DEMONSTRATION OF CO_2/METHYL FORMATE CO-BLOWING TECHNOLOGY IN THE MANUFACTURE OF EXTRUDED POLYSTYRENE FOAM

Project title	Demonstration project for conversion from HCFC-22/HCFC-142b technology to CO_2 with methyl formate co-blowing technology in the manufacture of extruded polystyrene foam at Feininger (Nanjing).
Country	China
Agency	UNDP
Sector	Foam
Subsector/application	Extruded polystyrene (XPS) foam
Enterprise/ systems house	Feininger (Nanjing) Energy Saving Technology Co. Ltd
Baseline technology	HCFC-22/HCFC-142b
Alternative technology	CO_2/methyl formate (MF)
GWP (alternative technology)	Negligible
Potential safety issues	MF: flammable as pure; CO_2: high pressure
ODS phase-out (mt)	205
ODS phase-out (ODP tonnes)	12.3

DESCRIPTION

Feininger is one of the lead enterprises in the XPS foam sector in China. In 2009 the enterprise manufactured 1,500 m^3 of XPS foam and consumed 630 mt of HCFCs. The project consisted in the conversion of one of the XPS foam manufacturing lines from HCFC-22/HCFC-142b to CO_2/MF co-blowing technology.

The project included:

- Evaluation of the retrofitting plan
- Equipment procurement, installation and commissioning
- Pilot running
- Product properties testing
- Industrial feasibility assessment
- Process and safety training

RESULTS

The demonstration project resulted in a reduction of 12.3 ODP tonnes of HCFC consumption and annual emission reductions of 420,250 tonnes CO_2-equivalent; demonstration and availability of an environmentally safe, cost-effective and replicable alternative for enterprises in the XPS foam sector in China and other Article 5 countries; usage of this product in different applications; and the adoption of safety standards in manufacturing XPS panels.

Feininger successfully updated its original extrusion foaming line and retrofitted the production plant's ventilation and fire safety systems. Co-blowing systems comprising of CO_2 and MF, and CO_2/MF/ethanol were evaluated. The demonstration concluded that the CO_2/MF formulation tested could be applied to XPS foam manufacturing, given that the thermal conductivity, compression strength and limited oxygen index were acceptable. It was also determined that using MF as the co-blowing agent of CO_2 had no significant influence on the process of producing XPS board.

XPS board testing and the relevant test report

Testing Item	Standard	Unit	50/50 CO_2/EtOH	50/50 CO_2/MF	50/20/30 CO_2/EtOH/MF
Thermal conductivity	GB/T 10294-2008	W/m.K	0.0345	0.0342	0.0336

COST ANALYSIS

The actual incremental capital costs for the conversion were US $1,743,186, of which US $1,557,635 was provided by the Multilateral Fund and US $185,551 was co-financed by the enterprise. The annual IOCs have been estimated by UNDP at US $531,200 (preliminary values). The calculation of the IOC was based on the use of new polystyrene resin materials rather than reclaimed materials. Reclaimed polystyrene material could also be used but the performance of the XPS foam would be reduced. XPS boards produced with CO_2/MF/ethanol needed five times more flame retardant than those using HCFC technology, increasing the product cost by about 20%.

CONCLUSION

The project established the suitability of CO_2/MF co-blowing technology as a viable replacement of the currently used HCFC-22/HCFC-142b in the manufacture of XPS foam.

Regarding the technology's applicability in other Article 5 countries, it could be used for XPS foam applications where safety requirements are not as stringent (e.g., frost insulation of roads, railways, traffic areas and other civil engineering applications), and depending on each country's safety requirements for construction materials.

The technology could be used at high latitude. In low-latitude countries, it could be applied by using pressure tanks for transportation and storage due to the low boiling point of MF. As these additional items increase costs, many of the XPS foam enterprises assisted by the HCFC phase-out management plan (HPMP) in China, including the second line of Feininger, have preferred to convert to CO_2 and ethanol instead of CO_2 and MF. Other reasons to select ethanol over MF are its accessibility, and the fact that auxiliary material for the technology is well-studied and mature in the country.

The cost of the equipment and of the safety transformation for the use of CO_2 and MF technology was higher than the cost of HCFC technology. As the new technology matures, if the cost decreases, it will be possible to use it in small and medium-sized enterprises.

FINAL REPORT AND SECRETARIAT'S COMMENTS

http://www.multilateralfund.org/73/English/1/7317a1.pdf
(paragraphs 3 to 14 and Annex I in page 21)