Multilateral Fund
for the Implementation of the Montreal Protocol

OBJECTIVE

To validate polyurethane (PU) foam formulations for discontinuous panels with reduced HFO to optimize the cost/performance balance to achieve a similar thermal performance to HCFC-141b-based formulations.

DEMONSTRATION OF COST-EFFECTIVE HFO FORMULATIONS FOR DISCONTINUOUS PANELS

Project title	Demonstration project to validate the use of hydrofluoro-olefins (HFO) for discontinuous panels in Article-5 Parties through the development of cost-effective formulations
Country	Colombia
Agency	UNDP
Sector	Foam
Subsector/application	Polyurethane (PU) foam/discontinuous panels
Enterprise/ systems house	Espumlatex
Baseline technology	HCFC-141b
Alternative technology	HFO-1233zd(E), HFO 1336mzz(Z)
GWP (alternative technology)	Negligible
Potential safety issues	Non-flammable
ODS phase-out (mt)	0
ODS phase-out (ODP tonnes)	0

DESCRIPTION

The project was designed to evaluate two HFOs as co-blowing agent in association with CO_2 derived from the water-isocyanate reaction: HFO-1336mzz(Z) and HFO-1233zd(E). The foam processing and physical properties obtained with these substances along with their formulating costs were compared to those of HCFC-141b-based systems. Espumlatex, a PU foam systems house equipped with 18 blending tanks and with a certified quality control laboratory, served as local technical host to coordinate the demonstration, foam application and testing activities.

RESULTS

- HFO-based formulations were developed with blowing agent reductions of 61 to 64 per cent by weight (equivalent to an HFO reduction in the gas cells of 60 per cent). These formulations do not present any additional environmental, safety and/or industrial hygiene issues.
- Compared to HCFC-141b-based formulations, the HFO-reduced formulations showed better foam flow; an initial foam k-factor that was 7 per cent higher, with similar k-factor values measured one month after injected; and similar laboratory and production plant values for compressive strength, dimensional stability and adhesion to metal.
- Handling and processability at the production plant of the HFO-reduced formulation was similar to HCFC-141b.
- There was no (statistical) difference between the performance of HFO-1233zd(E)-based foam and HFO-1336mzz(Z)-based foam.
- Under hot climatic conditions, the HFO-1233zd(E)-based systems could require storage conditioned to cool the formulated polyol storage and the formulated polyol day-tank to 20 to 25 degrees Celsius.
- For discontinuous panels and other rigid foam applications, the moulds should be equipped with temperature controls to ensure good performance.
- Initial work was undertaken to investigate 80-per-cent-reduced-HFO foam formulations. The results were promising but further trials were required.

COST ANALYSIS

At the time of the project implementation, the price of HFO-reduced systems was 16.4 to 33.2 per cent higher than the HCFC-141b-based system; however, this price could be lower in the future. Compared to HCFC-141b no additional capital was required for the preparation and testing of the HFO formulations at laboratory and industrial levels. The final report includes details on the incremental operational costs incurred in the demonstration.

CONCLUSION

The HFO-1233zd(E) and HFO-336mzz(Z) have boiling points of 19 and 33 degrees Celsius, respectively, and the trials were run at an ambient temperature ranging from 10 to 20 degrees Celsius. At hotter climates there may be a need with the HFO-1233zd(E) to cool the formulated polyol storage and the formulated polyol day-tank to 20- 25 degrees Celsius to avoid the excessive build-up of pressure. All the moulds used during the tests were equipped with heating systems and associated temperature controls (39 and 45 degrees Celsius). This is a critical condition to ensure good performance with reduced-HFO PU formulations. In addition to the results listed on the performance and processability of the HFO based formulations at the production plant, thanks to the technology formulation it was possible to significantly reduce the cost of the HFO based formulations.

FINAL REPORT AND SECRETARIAT'S COMMENTS

Additional details on this project are available at the link below:

http://www.multilateralfund.org/81/English/1/8110.pdf
(paragraphs 74 to 82 and Annex IV)