Multilateral Fund
for the Implementation of the Montreal Protocol

OBJECTIVE

To develop, optimize and validate the safe use of methyl formate (MF) as blowing agent as an alternative to HCFC-141b in the manufacturing of polyurethane (PU) foam

DEMONSTRATION OF METHYL FORMATE AS BLOWING AGENT IN THE MANUFACTURE OF POLYURETHANE FOAM

Project title	Pilot project for validation of methyl formate as a blowing agent in the manufacture of polyurethane (PU) foam
Country	Brazil
Agency	UNDP
Sector	Foam
Subsector/application	PU foam: flexible and integral skin, rigid insulation foam (15 applications)
Enterprise/ systems house	Purcom Quimica (Brazil) and Quimiuretanos Zadro (Mexico)
Baseline technology	HCFC-141b
Alternative technology	Methyl formate (MF)
GWP (alternative technology)	Negligible
Potential safety issues	Flammable pure
ODS phase-out (mt)	0
ODS phase-out (ODP tonnes)	0

DESCRIPTION

The project assessed the performance of MF-based systems compared to HCFC-141b-based systems in 15 PU foam applications. 14 applications were assessed and validated at Purcom Quimica Ltda., the largest independent systems house in Brazil. One application (shoe sole) was assessed and validated at Quimiuretanos Zadro, an independent systems house in Mexico. For the purpose of the project, acceptability was defined as:

- Determining the safe use of the technology based on health, safety and environmental data
- Determining the applicability of the technology based on its processability
- Determining the applicability of the technology by measuring relevant physical properties before and after replacing HCFC-141b
- Collecting complementary information and views from enterprises that have tested MF formulations in their production. The technology using MF in PU foam is owned and marketed by Foam Supplies, Inc. (FSI) in the United States of America.

RESULTS

Health, safety, environment: Safety equipment is required at systems houses handling pure MF; however, the risk is mitigated at the downstream-user level when using fully formulated MF-based systems within the content limits. MF-based systems do not pose an environmental hazard based on current knowledge/regulations.

System processability: Safety considerations are required for the shipment and storage of pure MF, while no special considerations are required for fully formulated systems with less than 6% MF (polyols) or less than 2% MF (MDI) following USDOT regulations; local regulations have to be consulted. MF-blended polyol systems for all applications except for integral skin foams are stable. MF-blended isocyanate systems are always stable. Blending in isocyanate is not recommended; instead it should be injected separately through a third stream as developed by Zadro for shoe soles. Although there is no conclusive evidence of corrosive effects, it is recommended that components that come in contact with MF or MF blends should be corrosion resistant. There are no compatibility issues between MF and polyols and/or additives; however, it is recommended that the compatibility of baseline polyols be checked when planning a conversion.

Foam properties: MF-based hyper-soft and viscoelastic foam matches HCFC-141b foam. MF-based flexible/semi-rigid/rigid integral skin, rigid foam for other appliances and spray foam match HCFC-141b foam within a 10% variation range. MF-based shoe-sole systems match or exceed HCFC-141b foam.

Summary of the results of the assessment of MF in PU foam applications

Foam Type	Application	Acceptability			
		Health, Safety and Environment (HSE)	Processability	Physical Properties	Assessment
Flexible and Integral Skin Foams	Hyper-soft molded	+	+	+	+
	Hyper-soft blocks	+	+	+	+
	Viscoelastic molded	+	+	+	+
	Viscoelastic blocks	+	+	+	+
	Steering wheels	+	+*	+	+
	Structural (rigid)	+	+*	+	+
	Semi-flexible	+	+	+	+
	Shoe soles	+	+*	+	+
Rigid Foams	Residential Appliances	+	-	-	-
	Other Appliances	+	+	+	+/-
	Panels, Transportation, Reefers	+	+	+	+
	Spray	+	+	+	+
	Blocks	+	+*	+	+
	Pipe-in-pipe	+	+	+	+
	Buoyancies	+	+	+	+

COST ANALYSIS

A cost template has been developed to calculate the incremental cost of conversion from HCFC-141b to MF-based foams. It should be pointed out, however, that capital and operating (chemical) costs can differ significantly from country to country and are affected by economy of scale, operations and the location of the supplier. Details on estimated costs can be found in UNDP's final report.

CONCLUSION

Analysis of the outcome of the assessment led to the following conclusions:

1) The use of MF as an alternative blowing agent to HCFC-141b in PU foam applications can be considered as an alternative in flexible/integral skin foam applications and in a number of rigid foam applications. For certain rigid foam applications, mainly domestic appliances, the technology cannot be recommended at this stage because the density required for this application cannot be reached by MF at the current level of technology (i.e., further optimization of the technology is required). For other appliances the technology should be analyzed on a case-by-case-basis and could be subject to further optimization

2) To minimize safety risks for downstream users, such projects should preferably be implemented through their system suppliers as fully formulated systems

3) Project designers should ensure that: chemical compatibility is verified; minimum packed density is observed; health, safety and environmental recommendations are incorporated; and implications related to acidity are taken into account.

FINAL REPORT AND SECRETARIAT'S COMMENTS

http://www.multilateralfund.org/62/English%20Document/1/6209.pdf
(paragraphs 18 to 30 and Annex in page 15)