EP

United Nations Environment Programme

Distr.
LIMITED

UNEP/OzL.Pro/ExCom/15/30
20 November 1994

ORIGINAL: ENGLISH

Executive Committee of
the Multilateral Fund for the
Implementation of the Montreal Protocol

Fifteenth Meeting
Montreal, 13-16 December 1994

PROJECT PROPOSALS: JORDAN

This document includes the following project proposals and the Fund Secretariat's Comments and Recommendations. The project proposals have been grouped by project sector. The agency responsible for the implementation of the project is also indicated. The project proposals are presented in the order indicated below. The Fund Secretariat's Comments and Recommendations are presented at the front of the document.

Aerosol

Foam

PROJECT EVALUATION SHEET

COUNTRY OR REGION:	Jordan
PROJECT TITLE:	Umbrella investment project for conversion to CFC-free technology at three flexible polyurethane foam factories, Arab Foam Factory, Jordan Plastics Co., National Foam.
BUDGET:	US $418,500
INCREMENTAL COSTS:	US $368,500
COST EFFECTIVENESS[1]:	US $0.60/kg/yr.
PROJECT DURATION:	9 months
IMPLEMENTING AGENCY:	World Bank
NATIONAL COORDINATING AGENCY:	Department of Environment
TECHNICAL REVIEW COMPLETED:	YES _X_ NO _

SECRETARIAT'S COMMENTS

1. There are currently four flexible foam companies in Jordan. In June 1992 a US $1.5 million line of grant was approved for the World Bank to undertake projects in Jordan. One project has been developed to phase-out CFC-11 at one of the companies (Kolaghassi) through the line of grant.

2. This umbrella project completes the phase-out activity in the flexible foam subsector. The capital costs relate mainly to improvement of the ventilation systems to allow for safe use of methylene chloride as a blowing agent.

3. The project has incremental savings of US $12,000 per year per factory. Following the comments of the Technical Reviewer indicating that savings can be achieved and discussion with the World Bank on the issue and taking account of risks associated with savings for such small factories it was agreed to take only 50 per cent, i.e. US $50,000 of the estimated savings into account in assessing the project incremental cost.

4. Consequently the agreed incremental cost was assessed to be US $368,500.

---

[1] Determined as the ratio of incremental costs to the estimated annual saving of ODP ($/$ODP_{kg}$).

SECRETARIAT'S RECOMMENDATION

5. The Fund Secretariat recommends approval and funding of the project at US $368,500.

SUB-PROJECT PROPOSAL

COUNTRY	:	Hashemite Kingdom of Jordan
PROJECT TITLE	:	Umbrella Project for Conversion to CFC-free Technology at Three Flexible Polyurethane Foam Factories
SECTOR COVERED	:	Foamed Plastics
ODS USE IN SECTOR	:	625T ods (779T ODP Equivalency)
PROJECT IMPACT	:	Eliminate the use of 114 tons/year CFC-11 (114 t ODP; 1993)
PROJECT DURATION	:	Nine Months
PROJECT ECONOMIC LIFE	:	Ten Years
TOTAL PROJECT COST	:	USD 418,500.00
PROPOSED MLF GRANT	:	USD 418,500.00
COST EFFECTIVENESS	:	USD 0.60/kg/yr
COORDINATING NATIONAL BODY	:	Jordan Department of Environment Division of Air Pollution
IMPLEMENTING AGENCY	:	World Bank

PROJECT SUMMARY:

The flexible slabstock industry in Jordan is concentrated in the city and suburbs of Amman. Two of the factories have made unsuccessful attempts toward the elimination of CFC's in the manufacturing process. They have selected methylene chloride as the replacement blowing agent (which is the correct choice), but have had problems with equipment that is not compatible with it. Methylene chloride is a much stronger solvent than CFC-11 and will require compatible seals and gaskets. It will also be more difficult to process, but with training and experience, yields can be as good as those with CFC-11. Methylene chloride is also classified as more toxic than CFC-11, so worker safety must be considered.

The factories are similar in operation and machinery, although there are specific differences that will be addressed in the individual company discussion. A major concern is inadequate ventilation in the manufacturing area. Minor concerns are the metering system for the methylene chloride and a water supply for fire protection within the proposed hoods.

In addition to equipment needs, a second component of this project should be technical assistance in the foam manufacturing process. The foam factories that had tried methylene chloride indicated a number of problems.

PROJECT OBJECTIVE:

Eliminate the use of CFCs in the manufacturing of flexible slabstock PUF at three remaining factories.

SECTOR BACKGROUND:

Jordan imports all of the CFCs used in the country. The CFC-11 is used in the manufacturing of flexible urethane foams and rigid insulation foams. The CFC-11 in the Jordanian foam sector, (including insulation foams for domestic and commercial appliances), has been established at 163 metric tons (Jordan Country Program, Table 2.1). On a prior mission, five flexible slabstock foam factories were identified. One has moved to Sudan (International Foam) and one (Kolaghassi) has been included in a prior project. The three remaining foam factories consumed 114 tons of CFC-11. The change to methylene chloride will therefore make a significant reduction.

ENTERPRISE BACKGROUND:

The Jordanian flexible slabstock industry has been made up of five factories, of which four are still in operation. The companies eligible for ML Fund assistance are:

Arab Foam	CFC-11.....	50 tons
Jordan Plastics	CFC-11.....	24 tons
National Foam	CFC-11.....	40 tons
TOTALS		114 tons

PROJECT DESCRIPTION:

The qualifying companies need exhaust fans and hoods which will control and remove the more toxic methylene chloride fumes. In some cases, Make-up Air will have to be provided. Since access to the foam will be restricted by the hood, water lances will be needed to take care of any fire danger.

The metering system for methylene chloride needs to be brought up to standard. A stainless steel day tank, piping, transfer pump, a pressure pump with motor, and a back pressure valve will be required for each factory. Some will need a flow meter that is compatible with methylene chloride.

TECHNOLOGY:

1. Overview

There are numerous technologies to replace the use of CFCs in flexible foams by non ODS or low ODS options. We refer to publications by UNEP and documentation available through UNDP for summaries of these technologies. Methylene chloride is one of the most cost effective technologies and is usually applied where process, industrial hygienic and regulatory conditions will permit it.

2. Selection

All of the Jordanian flexible slabstock companies have selected to phaseout CFCs in the slabstock production through replacement by methylene chloride.

3. Required Modifications

In all areas where methylene chloride and isocyanate are processed, adequate vapor containment and ventilation will have to be installed to assure safe workplace conditions.

The production line will need additional metering systems for the use of methylene chloride.

PROJECT COSTS:

1. Summary of Project Costs

The total project incremental cost of USD 418,500 is based on the incremental capital costs at the three qualifying factories. The net incremental recurrent cots are expected to be offsetting.

2. Capital Costs

The following cots are expected to be incurred:

Upgrading of ventilation and encapsulation systems	USD 286,000
Additional metering equipment	57,200
Production Trials, Chemical Losses	15,000
Technology Transfer	22,500
Contingency and rounding	37,800
TOTAL INCREMENTAL CAPITAL COSTS[1]	USD 418,500

3. Operating Costs

Methylene chloride is lower priced than CFC-11, resulting in lower material costs. Offsetting that is more difficult processing, higher costs of catalysis and polyol, annual training and maintenance.

1/ See Annex B for details.

These costs are difficult to calculate in advance as individual formulation changes and operating conditions tend to be site specific. However, expected annual savings on methylene chloride will approximately match the extra processing and chemical costs. Therefore, no recurrent incremental costs will be considered on this project. Annex C provided more detailed information.

UNIT ABATEMENT COSTS[2]

C	=	ODS reduction project costs	USD 418,500
F	=	Capital Recovery Factor	0.1627
OC	=	Incremental Operating Costs	USD 0.00
OS/R	=	Operating Savings or Revenue	0.00
ODP	=	ODP Reduction in First Year, Kilograms	114,000
		UNIT ABATEMENT COSTS	USD/kg/yr 0.60

FINANCING PLAN

The companies request an MLF grant, representing all eligible incremental costs in the amount of

USD 418,500

PROJECT IMPLEMENTATION

1. Management

World Bank will be the implementing agency for this project and will work with the recipient of project under the guidance of the Division of Air Pollution of the Government of Jordan.

2. Procurement

World Bank will review and supervise the procurement process, following World Bank Procurement Guidelines.

2/ $UAC = \frac{C(F) + (OC-OS/R)}{ODP}$

3. Schedule

TASK	TIME TO COMPLETION					
	Q1	Q2	Q3	Q4	Q5	Q6
1. Preparation						
MLF Approval	x					
Procurement preparation	xx					
Select vendor/contractor		x				
2. Installation						
Arrival, Customs			x			
Machine installation			x			
3. Start-Up						
Machine start-up			x			
Trials, training			xx			
Certification				x		

REQUIRED REGULATORY ACTION

The project does not require regulatory action.

PROJECT IMPACT

This project will eliminate the use of at least 114 tons of CFC-11 in the first year of implementation. In fact, with International Foam moved out of the country, the four remaining companies probably picked up that volume and the actual reduction of the combined Phase 1 and Phase 2 projects will be closer to 152 tons. The project employs commercially available and environmentally acceptable technology.

ANNEXES

Annex A: Individual Company Background
Annex B: Detailed information on Incremental Capital Costs
Annex C: Detailed information on Incremental Recurrent Costs.
Annex D: Individual Company Unit Abatement Costs.

ANNEX A

1. Arab Foam

Arab Foam is a 100% Jordanian owned company, founded in 1972. Their first foam machine was a Hyma which was replaced in 1979 with the present Laader Berg Maxfoam. The company employs 85 people, of which 10 are in the foam production area. The foam production manager is a Chemical Engineer. Arab Foam uses most of the foam they produce in manufacturing mattresses and upholstered furniture. They estimate they have a 25 to 30% share of the flexible foam market. Their CFC-11 usage was 50 tons in 1991.

The company proposes a 1,000 liter, 6 bar pressure tank with a chiller system, a variable frequency drive on a 3 to 22 liter/minute metering pump, rotameter, 3 way valve, and a 22,000 CFM exhaust fan.

In my opinion, the ventilation will be a major problem. The foam machine, near the pouring head, is not adequately enclosed, has too little exhaust and will need significant make-up air. The rear of the machine, near the Cut-Off Saw, also needs a hood and exhaust fan. The bottom paper take-off area is not ventilated well enough.

For the methylene chloride system, I suggest a stainless steel, 500 liter tank (not pressure rated) and a fixed speed pump with a back pressure control valve. Methylene chloride has a high affinity for dissolved air that creates small holes in the foam when the mixed liquids are dispensed to atmospheric pressure. A rotameter and manual flow control valve is very accurate, trouble free, and responds more quickly than most automatic systems. The 3 way valve for Recycle/Run positions should be remote operated, air actuated for rapid switching. An air operated diaphragm pump (with compatible gaskets and seals) would be used for transferring methylene chloride from drums to the stainless steel tank.

2. Jordan Plastics Company

Jordan Plastics is a 100% Jordanian owned company, founded in 1971. Their foam machine is a Laader Berg Maxfoam which was installed in 1976. The company employs 225 people, of which 5 are in the foam production ares. The foam production manager is a Chemical Engineer. They have a mechanical handling system and crane for moving hot and cold buns up to 10 meters longs. Jordan Plastics uses most of the foam they produce in manufacturing mattresses and upholstered furniture. They estimate they have a 15 to 20% share of the flexible foam market.

For the methylene chloride system, I suggest a stainless steel, 500 liter tank (not pressure rated) and a fixed speed pump with a back pressure control valve. the 3 way valve for Recycle/Run positions should be remote operated, air actuated for rapid switching. An air operated diaphragm pump (with compatible gaskets and seals) would be used for transferring methylene chloride from drums to the stainless steel tank.

Ventilation will be a major problem. For temperature control, the company has enclosed the front end of the foam machine. It is closed off from the rest of the room and from outside. It has too little

exhaust and will need significant make-up air. The make-up air will need to be heated in the printer. The rear of the machine, including the Cut-Off Saw and take-away conveyor, needs a hood and exhaust fans.

3. National Foam Factory

National Foam is a 100% Jordanian privately owned company, founded in 1968. Their foam machine is a small (40 kilos/minute polyol throughput) Hennecke installed in 1968. It does not have a mechanical mixhead, but uses high pressure injection nozzles and Bosch pumps (2 to 8 cylinder, in line pumps) to achieve the mixing. The machine and pumps are well maintained and the foam is good quality. The company employs 23 people (down from 45 prior to the Gulf War), of which 8 are in the foam production department. They use the foam for manufacturing mattresses, but supply several independent foam fabrication factories that cut foam for their own uses. National is estimated to have 40% of the foam market.

Ventilation will be the major problem. The factory is located in the basement of the building and there is insufficient make-up air. An air supply system will need to be installed. The present exhaust system discharges through the wall into the same general area where the make-up air will be coming from. The stacks will have to be extended above the roof line (3 floors up) to avoid recycling the fumes. Hooding the exhaust fans will need to be installed from the rear of the machine to the point where the take-away conveyor exits the building. The curing area is a concrete pad with a shed roof and will not need additional ventilation.

The present tank for CFC-11 should be replaced with a 500 liter stainless steel tank (not pressure rated) and a fixed speed pump with a back pressure control valve to supply methylene chloride to the present Bosch pump. An air operated diaphragm pump (with compatible gaskets and seals) would be used for transferring methylene chloride from drums to the stainless steel tank.

The present rubber lined, high pressure hoses (from the polyol manifold where methylene chloride is introduced, to the manifold where TDI is introduced) will need to be replaced with steel braided, Teflon lined high pressure hose. The traversing hose portion can be a low pressure, plastic hose that is disposable.

ANNEX B

1. Arab Foam Factory

Equipment Description	USD Cost
Methylene Chloride System:	
500 Liter, stainless steel, unrated, pump, valve, tuging	16,000
3 Way Valve and Air Actuated Operator	1,000
Rotameter	1,000
Chiller and Heat Exchanger	5,000
Tranfer Pump	400
Sub-total	23,000
Ventilation:	
Make-Up Air	20,000
Main Conveyor Hood and Fan	10,000
Hood and Fans for Transition Conveyor and Cut-Off Saw	60,000
Water Lances and Piping	2,000
Sub-total	92,000
Production Trails (Chemical Losses)	5,000
Technology Transfer, (estimate 3 trips, 5 days, cover 4 plants)	7,500
Contingency and Rounding	13,100
TOTAL	141,000

2. Jordan Plastics Company

Equipment Desciption	USD Cost
Methylene Chloride System:	
500 Liter, stainless steel, unrated, pump, valve, tubing	16,000
3 Way Valve and Air Actuated Operator	1,000
Transfer Pump	400
Sub-total	17,400
Ventilation:	
Make-Up Air	30,000
Main Coneyor Hood and Fan	10,000
Hood and Fans for Transition Conveyor and Cut-Off Saw	60,000
Water Lances and Piping	2,000
Sub-total	102,000
Production Trials (Chemical Losses)	5,000
Technology Transfer, (estimate 3 trips, 5 days, cover 4 plants)	7,500
Contingency and Rounding	13,100
TOTAL	144,000

3. National Foam

Equipment Description	USD Cost
Methylene Chloride System:	
500 Liter, stainless steel, unrated, pump, valve, tubing	16,000
Transfer Pump	400
Sub-total	16,400
Ventilation:	
Make-Up Air	20,000
Main Conveyor Hood and Fan	10,000
Hood and Fans for Transition Conveyor and Cut-Off Saw	60,000
Water Lances and Piping	2,000
Sub-total	92,000
Production Trails (Chemical Losses)	5,000
Technology Transfer (estimate 3 trips, 5 days, cover 4 plants	7,500
Contingency and Rounding	12,100
TOTAL	133,000

m:\poly

ANNEX C

RECURRENT INCREMENTAL COSTS

Two companies tried the conversion from CFC-11 to methylene chloride approximately two years ago. They did not continue because of high maintenance costs (seals and gaskets) and production processing problems (high scrap rates). It is normal to drop 5% to 10% in prime yield in factories where that change in ABA is instituted. The initial losses will be even higher, but proper formulation and operating techniques will fairly quickly regain all but the last 5 to 10%. Because foam pouring is somewhat of an art and solutions are site specific, the final percentage improvements will have to be made over the long term by the operators at each factory. With some process training and help with formulations, the companies should recover to the 5% level within a few months.

In the process 114 tons/year of CFC-11 will be replaced by 114 tons/year of methylene chloride. In addition, the catalysts and polyol have to be changed, recurrent safety training, operating costs for the extra ventilation and increased maintenance will be needed. Assuming 2,200 tons of foam poured annually, these will impact the operating cots as follows:

ITEM	Before	After
114 T/Y CFC-11 @ 2500	USD 285,000	-
114 T/Y Methylene Chloride @ 1500	-	USD 171,500
0.45 T/Y Extra Amine Catalyst @ 7500	-	3,375
1.00 T/Y Extra Tin Catalyst @ 5600	-	5,600
Annual electricity for forced ventilation	-	3,500
Training and Maintenance	-	20,000
Incurred Costs From Prior Conversion Efforts:		
First year yield: Incremental Gain Loss= 5% x 2200 T/Y @ 1650	 USD 131,025 - 181,500 - 50,475 x	 1.0000=USD50,475
Second year yield: Incremental Gain Loss= 2.5% x 2200 T/Y @ 1650	 USD 131,025 90,750 + 40,275 x	 0.9090=USD36,610
Third year yield: Incremental Gain Loss= 0% x 2200 T/Y @ 1650	 USD 131,025 0 USD 131,025 x	 0.8260=USD108,227
Fourth year yield: Incremental Gain Loss= 0% x 4500 T/Y @ 1650	 USD 131,025 0 USD 131,025 x	 0.7513=USD 98,439
NET FOUR YEAR TOTAL		USD192,801

JORDAN - UMBRELLA PROJECT FOR ARAB FOAM FACTORY, JORDAN

PLASTICS COMPANY AND NATIONAL FOAM

TECHNOLOGY

In all three cases methylene chloride is proposed for the replacement of CFC 11 as an auxiliary blowing agent for the production of flexible polyurethane foam slabstock. This is now an industry standard and is widely used in developed and developing countries. It is a cost effective technology but one where adequate attention has to be paid to health and safety considerations (see below).

Some such conversions require the use of accelerated curing systems, to prevent scorching and especially when only methylene chloride of substandard is available. This is presumably not the case in these instances.

ENVIRONMENTAL ISSUES

Methylene chloride has a very low ODP (it is not a classified substance) and a zero GWP and is, therefore, a long term solution.

The main issues relate to health and safety in the three factories. The reviewer has examined the measures and equipment proposed to improve ventilation and there appear to be satisfactory.

It is essential that the staff in the three factories receive a thorough training in safe working from experts experienced in operating such factories using methylene chloride. The reviewer assumes that this is included within "technology transfer" but requires that safety training measures are exemplified.

PROJECT COSTS

The capital costs are all for necessary equipment and appear to be of a reasonable order when compared to other, similar projects.

The projects are judged to be neutral on operating cost. However, in many other similar projects an overall saving is achieved. It is recommended that this aspect be reexamined and a calculation made in each case.

Nevertheless, the unit abatement cost of $0.60/kg/yr indicates a cost effective project.

IMPLEMENTATION TIMEFRAME

This appears to be achievable at 12 months for the overall project.

RECOMMENDATION

Approved subject to the comments above on safety training and operating costs.

GMFJ/kd/20/10/94

ANNEX D

Unit Abatement Costs

	Arab Foam	Jordan Plastics	National Foam
C =ODS reduction project costs	USD 141,000	USD 144,000	USD 133,000
F =Capital Recovery Factor	0.16275	0.16275	0.16275
OC =Incremental Operating Costs	0.00	0.00	0.00
OS/R=Operating Savings or Revenue	0.00	0.00	0.00
ODP=ODP Reduction 1st year kilogram	50,000	24,000	40,000
Unit Abatement Costs* (USD/kg/yr)	**0.46**	**0.98**	**0.54**

$$*UAC = \frac{C\,(F) + (OC\text{-}OS/R)}{ODP}$$

On the balance, a slight increase in incremental recurrent costs appears to exist. However, as the yields improve, the potential lower costs over the remaining 2 years offset the first 2 years loss. That should be considered as balancing the possible 4 year incremental recurrent costs. The possible net gain of USD 193,000 illustrated in this calculation represents only USD 12,000 per year per company.

It is acknowledged that these figures are estimates. Individual formulation modifications will result from the process trials and yields may differ from the predicted costs, but they certainly won't be better than the original CFV formulas. On that basis, recurrent incremental costs will not be considered.