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Seventeenth Meeting
Montreal, 26-28 July 1995

PROJECT PROPOSAL: PERU

This document includes the following project proposal:

- Elimination of CFC-12 in the production of Polystyrene Foam at Promola — UNDP

PROJECT COVER SHEET

COUNTRY:	**PERU**
PROJECT TITLE:	Elimination of CFC 12 in the production of Polystyrene Foam at PROMOLA (Productos Moldeados America S.R. LTDA)
SECTORS COVERED: ODS USE IN SECTOR	Foamed Plastics 70 tons CFCs in 1991
PROJECT IMPACT:	Phase out of 40 tons total per year of CFC-12
PROJECT DURATION: PROJECT ECONOMIC LIFE	One year 10 years
TOTAL PROJECT COSTS:	USD 584,100 Incr. Capital Cost (USD 264,938) Incr. Recurrent Benefits
PROPOSED MLF GRANT	USD 319,162
UNIT ABATEMENT COST COST EFFECTIVENESS	USD 4.47 /kg/yr. USD 7.98 /kg/yr.
NATIONAL COORDINATING BODY:	Grupo de Trabajo para la Implementacion del Programa Pais (GTIPP)
IMPLEMENTING AGENCY:	UNDP
APPRAISAL DATE:	May 1995

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PROJECT SUMMARY

Productos Moldeados America S.R. LTDA(PROMOLA), a fully Peruvian owned company, manufactures extruded polystyrene (PS) foam sheet for thermoforming into meat trays, egg cartons, egg trays, and dinner service ware. The company intends to phase out the current use of CFC-12 through the introduction of 100% hydrocarbon (isobutane). In this way, the company expects to be able to maintain the same product quality. Under this project, PROMOLA will eliminate the use of CFCs in their process resulting in an annual reduction of 40 tons of ODS. The project contains safety features to address the hazards created by the use of a flammable substance. The company should reduce their operating costs. The current building and production equipment must be extensively modified in order that they can be used with a hydrocarbon blowing agent. In addition, appropriate safety procedures need to be established and followed. Technology for the retro-fitting will be provided by the UNDP expert.

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Project prepared by Mr. Dennis Knauss, reviewed by Mr.Bert Veenendaal
Independant Technical Review: Dr. Hubert Creyf

PROJECT OF THE GOVERNMENT OF PERU

ELIMINATION OF CFCs IN THE MANUFACTURE OF EXTRUDED POLYSTYRENE FOAM SHEET AT PRODUCTOS MOLDEADOS AMERICA S.R. LTDA(PROMOLA)

1. PROJECT OBJECTIVE

The object of this project is to phase out the use of CFCs in the manufacture of extruded polystyrene (PS) foam sheet at Productos Moldeados America S.R. LTDA(PROMOLA).

2. SECTOR BACKGROUND

The country programme which is currently under preparation, will be presented at the 17th Executive Committee Meeting. It estimates that the foam sector in Peru consumes about 70 tons/year of CFCs.

PROMOLA is the only manufacturer of extruded polystyrene foam in Peru, consuming 40 tons/year of CFC 12, and is therefore the largest CFC consumer in the foam sector in Peru.

3. ENTERPRISE BACKGROUND

PROMOLA was founded in 1976 and is a 100% Peruvian owned company founded in 1976. PROMOLA manufactures extruded polystyrene (PS) foam sheet for thermoforming and lamination. They thermoform the PS foam into meat trays, egg cartons, egg trays, and dinner service ware. PROMOLA is the only manufacturer of polystyrene foam in Peru.

The company intends to phase out the current use of CFC-12 through the introduction of 100% hydrocarbon (isobutane) as the blowing agent. In this way, the company expects to be able to maintain the same product quality.

PROMOLA uses an LMP RC-19/18 (120 mm) co-rotating twinscrew extruder to produce its polystyrene foam. In addition to the extrusion equipment, the reclaim extruder will also need to be modified. More information on this equipment is annexed.

The current building is suitable for the use of a flammable substance. However, the plant and production equipment must be extensively modified for this use and appropriate safety procedures need to be established and followed.

PROMOLA's normal product mix of thermoformed products is expected to grow at a rate in excess of 20% per annum. This is related to the expanding export industry, general business expansion, as well as modernization of existing facilities. Capacities of CFC use

at PROMOLA may therefore increase rapidly in coming years to reach maximum production levels of 60 to 70 tons/year.

4. PROJECT DESCRIPTION

PROMOLA utilizes annually about 40 tons CFC-12 in the manufacture of extruded PS foam sheet. Management is committed to the phase out of this ozone depleting compounds.

PROMOLA intends to phase out the current use of CFC-12 through the introduction of 100% hydrocarbon. It is possible to adapt the existing building and equipment for this purpose, if extensive changes are made. In addition to these changes, safety related modifications in the production environment have to be implemented to mitigate fire and explosion hazards when using a hydrocarbon. Finally, extensive production and safety training is needed to guarantee a smooth and safe operation and to conform to the strict Federal, State, and Local fire standards in Peru. In this way, the company expects to be able to maintain the same product quality and insulation value of its products at acceptable levels.

5. TECHNOLOGY

5.1 OVERVIEW AND SELECTION

There are the following options available in Peru to replace CFCs in the production of extruded PS foam sheet, such as:

- Hydrocarbon
- Hydrocarbon and CO_2
- HFC-134a
- HFC-152a

A summary of these technologies, their potentials and their limitations is provided through the UNEP Technical Options Committee bi-annual review (1995).

A 100% hydrocarbon (isobutane) will be selected by the company as an alternative and either blowing agent system is:

- Proven technology; in processing and product performance,
- Environmentally acceptable
- Low in toxicity,
- Adaptable to the existing equipment.

A draw back of 100% hydrocarbon is their high flammability requiring stringent safety precautions.

Users of hydrocarbons are subject to stringent Federal. State, and Local fire regulations, including the appointment and training of company safety experts for every shift. The emission of hydrocarbon is not regulated in Peru, nor are restrictions expected in the foreseeable future.

Regarding the choice between a blend of a hydrocarbon and CO_2 (referred as blend-option) and the hydrocarbon-only option, it should be noted that the company may eventually choose for the blend option. However, since this option is more expensive. the company accepts that the project is based on the (cheaper) hydrocarbon-only solution. FANDEC may wish to go to the blend solution at a later date, but is then prepared to bear the additional cost in this connection.

5.2 PRODUCTION PROCESS

The use of 100% hydrocarbon will require substantial changes in the plant, production process and storage.

The following represents a brief description of the equipment modifications and additions that PROMOLA will have to implement to use a hydrocarbon blowing agent to make polystyrene foam:

- **Plant Exhaust System**
  - The plant/warehouse air must be moving at all times and should be changed every hour.
  - Exhaust ducts mounted at floor level and parallel to the foam extrusion line.
  - Exhaust ducts to draw fresh air across the plant floor in the foam storage area.
  - The Lower Explosive Level(LEL) for Hydrocarbon is about 0.5%.
  - Target level of Hydrocarbon in the plant should be less than 0.05%.
  - The exhaust fans do not need explosion proof motors.

- **Extrusion Exhaust System**
  - Extrusion line should have its own system that targets specific areas such as the feedthroat, injection port, die/sizing mandrel, foam sheet path or winder.

- **Ceiling Fans**
  - Production area and the warehouse should have ceiling fans spaced 10 to 13 meter apart.
  - Fans should run continuously and should keep the air circulating to prevent pockets of Hydrocarbon from building up.

- **Foam Storage**
  - Air must be moving at all times by using ceiling circulating fans and wall mounted exhaust fans at floor level.

- Fans should be spaced 10 to 13 meter apart with louvered openings located on the wall opposite the exhaust fans.
- Exhaust ducts to draw fresh air across the plant floor in the foam storage area.
- Polyethylene bags used to package "fresh" rolls should have holes to allow the Hydrocarbon to flow out and fresh air to flow in. The holes should be about 12 to 14 mm in diameter and spaced about 150 to 200 mm apart.
- Stack rolls on pallets to circulate air around the rolls more easily.

- **Hydrocarbon Sensing Equipment**
  - Hydrocarbon monitoring device to detect its level near bulk storage tank, high pressure pump, extruder and surrounding area, reclaim grinder, converting area and foam storage area.
  - Automatic shutdown of hydrocarbon when sensor monitor exceeds preset limit.
  - Handheld hydrocarbon Sensor to monitor the hydrocarbon at random locations throughout the plant.

- **Bulk Storage Tank**
  - Installation and location of hydrocarbon blowing agents systems are subject to compliance with Federal, State and Local regulations. The recommended design pressure for a hydrocarbon blowing agent container is 250 psig. This will allow storage of propane which exerts the maximum vapor pressure.
  - The tank should have an electrically/pneumatically operated shutoff control valve on the outlet pipe of the tank that can be activated from within the plant. In addition, the electrical power supply to the tank should shutoff from within the plant as well as at the tank.
  - There should be a pneumatically/manually operated shutoff valve just prior to the high pressure pumps.

- **High Pressure Hydrocarbon Pumping and Metering System** needs to be replaced.

- **Cast Aluminum Heaters** with explosion proof terminal boxes on the gate and die.

- **Dosing and Blending System** to meter and blend the polystyrene resin with nucleator, color, and other processing aids.

- **Gravimetric Feeder** to accurately control the feed rate of the polystyrene pellets into the extruder

- **Endothermic Nucleator** instead of talc to maintain the same size cells and product integrity.

- **Feedscrew Oil temperature Control System**

- **Melt Blender**

- More uniform melt temperature is required, when hydrocarbon is used as the blowing agent, to achieve the same cell size and quality of product.

- **Barrel Temperature Control System**
  - More cooling is required and it must be more accurately done when a hydrocarbon blowing agent is used.

- **Sheet Die and Air Rings**
  - The die geometry and design must generate sufficient back pressure and flow uniformity. In addition, air rings are required to impart a "skin" to the foam sheet's surface.

- **Ventilation Supply Blower System**
  - Air supply blowers should be installed to supply fresh air to electrical equipment located in areas that can develop high levels of hydrocarbon. The blowers create a positive pressure within the electrical units and should supply air to the extruder's control panel, main drive motor, underneath the extruder base frame, the oil circulating pumps for the transmission and the thrust bearing assemblies, the shed that houses the high pressure hydrocarbon pump, the sizing mandrel blowers, that supply air to the inside and outside foam surfaces.

- **Ionized Air Blower**
  - Ionized air is blown onto foam surfaces to neutralize static charge build-up. The blowers should be placed on the take-off equipment so that the ionized air is blown onto the foam web at the sizing mandrel stand, S-wrap/pull rolls, winder, reclaim grinder and converting equipment.

- **Clothing**
  - The operators should be given static resistant shoes and clothing.

- **Shipping Precautions**
  - If hydrocarbon blown foam is placed in an enclosed container such as a truck trailer, the driver must use care when opening the trailer doors. This is especially true when ambient temperatures are above 10 °C. The driver should guard against generating any sparks and should not smoke or use an open flame near the truck.

Production and aging areas are to be separated from other working areas and fitted with sprinklers or otherwise protected against fire hazards.

Production and maintenance personnel have to be trained in the safe handling of hydrocarbons, in addition to production training.

Start-up trials will be necessary to adjust for formulation modifications, processing conditions and product evaluation.

Hydrocarbon gas and temperature alarm systems will be installed throughout this building. The hydrocarbon bulk storage tank will be located in compliance with Federal, State, and Local fire regulations and protected with hydrocarbon sensors and deluge sprinkler system. Large fire extinguishers will be staged at all critical places; portable fire extinguishers will be placed at every entrance. Initial and follow up fire safety training will be implemented. Production and maintenance personnel will also be trained in the safe handling of hydrocarbons, in addition to production training.

Start-up trials will be made to adjust for the different formulations and processing conditions. The start-up will be supervised by a technology and process specialist.

6. PROJECT COSTS

6.1 Capital Costs

The following is a summary of the expected costs of investment and related activities (in USD):

Description	Cost
Exhaust System	45,000.00
Cast Heaters with explosion proof terminal boxes	8,500.00
Dosing and Blending System	75,000.00
Grinder Modifications	5,000.00
High Pressure Pump/Metering System	75,000.00
Air Pressurization Systems	15,000.00
Sprinkler System	25,000.00
Bulk Storage Tank	80,000.00
Feedscrew Oil Temperature Control System	10,000.00
Foam Sheet Die and Air Rings	60,000.00
Melt Blender	20,000.00
Bulk Storage Tank- Deluge System	15,000.00
Ceiling Fans	12,000.00
Simco Antistatic Blowers and Bars	25,000.00
Hydrocarbon Plant Sensing System	40,000.00
Hand Held Hydrocarbon Sensor	1,500.00
Clothing	4,000.00
Technology Transfer & Training by UNDP	15,000.00
SUBTOTAL	**$531,000.00**
10% Contingency	**53,100.00**
TOTAL	**$584,100.00**

The costs are based on information from a recently budgeted project in Colombia (equipment modifications, safety systems), from local suppliers (tank) and from UNDP (training, technology transfer).

6.2 OPERATING COSTS

The following are the current costs for CFC-12 and its intended replacement, isobutane (cost in the U.S.A.)

CFC-12	$3.265 USD/kg
Hydrocarbon	$0.58 USD/kg

However, as no isobutane is available in Peru, a price of US$ 1.00 per kg is considered in the calculations to take freight costs into account. A ratio of 1:2 replacement of CFC-12 by hydrocarbon is assumed. This amounts to an expected annual decrease in material costs of: :

	Price US$/kg	Annual Consumption (kg)	Cost US$
CFC	3.265	40,000	130,600
Isobutane	1.00	20,000	20,000
Annual savings due to material costs			110,600

The projected savings need to be off set against the higher costs in maintenance, insurance, safety monitoring and ongoing safety training. These costs are estimated to be about USD 27,000 per year.

The resulting annual savings are therefore estimated at
110,600-27,000 = US$ 83,600
which translates in a Net Present Value (NPV) based on 4 years and 10% of US$ 264,938.

6.3 UNIT ABATEMENT COST

a)	ODS Reduction Project Costs	USD 584,100
b)	Capital Recovery Factor (for 10 years)	0.16275
c)	Annual Incremental Recurrent Benefits	USD 83,600
d)	ODS Reduction/year	kg 40,000
	Unit Abatement Costs[(a * b + c)/d]	USD/kg/year 4.47

The cost-effectiveness amounts to (584,100 - 264,938) / 40,000 = 7.98 US$/kg/yr

7. FINANCING PLAN

The company requests the reimbursement of the complete project costs estimated on

USD 319,162

8. PROJECT IMPLEMENTATION

8.1 MANAGEMENT

UNDP will oversee the implementation of this project and provide technical assistance.

8.2 SCHEDULE

Implementation schedule will start with MLF approval of the project and will end after monitoring has confirmed that at no place on the machine or in the working area unsafe levels of hydrocarbon can be detected.

TASK	TIME FOR COMPLETION					
	Q1	Q2	Q3	Q4	Q5	Q6
1. Preparation						
MFL Approval	x					
Visit Consultant	x					
Order Confirmation		x				
2. Installation						
Arrival, Customs			x			
Machine Modifications			x			
Tank Installation			x			
Safety Devices			x			
3. Start-up, Training						
Machine Start-up				x		
Safety Training				x		
Commissioning				x		

8.3 PROCUREMENT

UNDP will over see the procurement. UNDP expects at about the same time to procure two(2) similar projects, resulting in procedural and cost efficiencies. These factors were already taken into account in the above cost calculations. Assistance will be provided by a UNDP Process Consultant.

9. PROJECT IMPACT

This project will eliminate the use of at least 40 tons of CFCs in the first year of implementation. The project employs commercially and environmentally acceptable technology.

TECHNICAL REVIEW.

1.Country:

PERU

2.Project Title:

Elimination of CFC 12 in the production of Polystyrene Foam at PROMOLA (Productos Moldeados America S.R. LTDA)

3.(Sub)Sector:

Foamed Plastics

4.CP-Relationship:

The national coordinating body is the Grupo de Trabajo para la Implementacion del Programa Pais. UNDP is the implementing body.

5.Technology:

The company wants to replace a yearly amount of 40 T of CFC 12 by isobutane. Although technologically not difficult, the use of hydrocarbons demands introduction of safety hard- and software.
The hardware safety precautions are well described in the project.

Perhaps an extra word is needed on the transportation of hydrocarbons in pipes: electrostatic electricity can be built up and hence the whole equipment must be earthed. Pipes used for hydrocarbon transport must be marked by colour code, so that they are not unintentionally hot-welded.
It is further important to foresee the sprinkler installation with the correct extinguishing materials, adapted for hydrocarbons.
As for management procedures, it is necessary to inform and train personnel, including training for emergency situations.

6.Environmental Impact:

Isobutanes have no ODP and GWP. The smog potential is the main environmental disadvantage. CFC 12 has an ODP of 1 and a GWP of ± 3.

7.Project Costs:

The capital costs mentioned are correct.

It is unclear whether the hydrocarbon monotoring system is included in the costs mentioned for Exhaust System.

The incremental operational savings seem correctly calculated.

The cost for elimination of 1 kg of ODS is USD (319,162 / 40,000) or USD 7.98.

8.Implementation:

Correct as presented. It is questioned whether 1 year is enough for such a dramatic change.

9.Recommendation:

It is recommended to accept this project.

Prepared by Hubert Creyf, UNDP Foam Sector Reviewer.

Date: 060595