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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Twenty-third Meeting
Montreal, 12-14 November 1997

**DRAFT GUIDELINES FOR LIQUID CARBON DIOXIDE
TECHNOLOGY IN FOAM PROJECTS**

1. At its 22nd Meeting the Executive Committee approved 6 flexible slabstock polyurethane foam projects using liquid carbon dioxide as substitute blowing agent (LCD projects). In each of these projects, based on a one time agreement between the Fund Secretariat and the Implementing Agencies involved, the incremental operational savings had been taken as 25 per cent of the capital costs. In approving the projects the Executive Committee decided:

- a) To urge the Secretariat and the implementing agencies to finalize their discussions on guidelines for liquid carbon dioxide projects and submit recommendations on the subject to it at its Twenty-third Meeting.
- b) That liquid carbon dioxide projects could be submitted to its Twenty-third Meeting and approved for funding on the basis of the guidelines agreed at that Meeting, on the understanding that, if no guidelines were approved, consideration of the projects would be deferred until such time as they were.

2. Subsequently the Secretariat and the Implementing Agencies agreed upon terms of reference for the preparation of a report to enable them to make recommendations on the guidelines for consideration by the Executive Committee at its 23rd Meeting.

3. The report includes background information on the technology as used in the production of both flexible slabstock and flexible molded polyurethane foams, comparison with other technologies applied under the Multilateral Fund, selection criteria, categories of capital costs, elements necessary for determining the incremental operating costs/savings as well as a proposed methodology for their calculation. The Secretariat and the agencies agreed that the yield loss proposed in the report (4 & 2%) should be applied for the projects submitted to the 23rd Meeting since further calculation of this percentage was deemed necessary (the report is available from the Fund Secretariat).

4. On the basis of the report, the attached draft guidelines for liquid carbon dioxide technology in foam projects (Annex 1) are being submitted for consideration by the Executive Committee.

5. Fourteen (14) flexible slabstock and two (2) flexible molded foam projects for liquid carbon dioxide have been submitted to the 23rd Meeting where both incremental capital and operating costs are calculated according to the draft guidelines. The Fund Secretariat and the Implementing Agencies have discussed the projects submitted and agreed on the elements of the project costs, except the Cameroon projects which have been submitted for individual consideration. Annex II lists the projects including their costs as calculated according to the draft guidelines.

RECOMMENDATION

1. The Executive Committee may wish to approve the draft guidelines to be applied for a trial period of one year.

Annex I

DRAFT GUIDELINES FOR LIQUID CARBON DIOXIDE PROJECTS

1. For a trial period of one year:

- (a) Liquid Carbon Dioxide (LCD) technology, may be applied in flexible slabstock polyurethane foam projects, where the annual CFC consumption of the enterprise is higher than 50 tonnes, except where national regulatory restrictions or other compelling reasons e.g.: the need to meet local market competition, prevent the use of methylene chloride, evidence of which should be attached to the project document:
- (b) In flexible molded polyurethane foam projects where both LCD and water-blown technologies are viable zero-ODP options, an enterprise would be free to choose its technology subject to the provision that the eligible grant would be based on the more cost-effective of the two technology options.

2. Incremental Capital Costs

(a) Flexible Slabstock Polyurethane Foam Projects

The calculation of the eligible incremental capital costs of LCD projects should be based on the following:

Category	Cost Element	Cost (US\$)
Technology	Technology acquisition	50,000 ¹
	Technical support	10,000 to 30,000
	Training	10,000
	Trials	15,000
	Commissioning/Training	10,000 to 30,000
Equipment	LCD Unit	250,000 to 375,000
	CO ₂ transfer system	20,000 to 40,000
	Miscellaneous Metering Units	70,000 to 85,000
Civil works		25,000
Total		460,000 to 660,000

¹ The technology licence fee is not subject to 10% contingency.

(b) Flexible Molded Polyurethane Foam Projects

The calculation of the eligible incremental capital costs of LCD projects should be based on the following:

Category	Cost Element	Cost (US\$)
Technology	Technical support	10,000 to 20,000
	Trials	10,000 to 20,000
Equipment	LCD Unit	80,000 to 140,000
	CO ₂ transfer system	0 to 25,000
	High pressure metering units	0 to 90,000
Civil works		5,000
Verification testing		5,000
Total Incremental Capital Cost		225,000 to 300,000

3. **Incremental Operational Costs/Savings**(a) Flexible Slabstock Polyurethane Foam Projects:

The calculation of the eligible incremental operational costs or savings should be based on the following parameters:

Cost Category	Costs Calculation	Cost Range (US \$)
Chemical Costs	See attached template	0.09 - 0.11
Yield loss	4% first year 2% second year 0% third year 0% fourth year	N/A
Other Costs		
• Maintenance	5% of eligible capital items	12,000 - 18,000
• Power	actual power increase	3,500 - 5,000
• LCD tank	actual lease costs ²	4,500 - 5,000

² Where it is not feasible to lease the LCD tank, the cost of a tank in the range of US \$15,000 - US \$25,000 may be included in the capital costs.

(b) Flexible Molded Polyurethane Foam Projects

The calculation of the eligible incremental operational costs or savings should be based on the following parameters:

Cost Category	Costs Calculation	Cost Range (US \$)
Chemical Costs	See attached template	0.15 - 0.25
Other Costs		
• Maintenance	5% of eligible capital items	4,000 - 11,000
• Power	actual power increase	0 - 5,000
• LCD tank	actual lease costs	0 - 3,000

4. **Methodology for the Calculation of Incremental Operational Cost/Savings**

The methodology for calculation of the incremental operational costs or savings should be based on the template in Appendix 1. (The template includes a User Guide which provides explanations of various parameters as well as formulae for calculations of various costs.)

Appendix 1

Liquid Carbon Dioxide Projects (Slabstock)**TEMPLATE FOR CALCULATION OF INCREMENTAL OPERATIONAL COST/SAVINGS**^{(1) (2)}

CHEMICAL	PRICE (\$US/kg)	FORMULATION C.F.C.		FORMULATION L.C.D.	
		Kg	\$US	Kg	\$US
Polyol	(1)	(2.1)	(3.1)	(2.2)	(3.2)
Polymerpolyol	(1)	(2.1)	(3.1)	(2.2)	(3.2)
TDI	(1)	(2.1)	(3.1)	(2.2)	(3.2)
Water	(1)	(2.1)	(3.1)	(2.2)	(3.2)
CFC-11	(1)	(2.1)	(3.1)	(2.2)	(3.2)
LCD	(1)	(2.1)	(3.1)	(2.2)	(3.2)
Tertiary amine	(1)	(2.1)	(3.1)	(2.2)	(3.2)
Tin octoate	(1)	(2.1)	(3.1)	(2.2)	(3.2)
Surfactant	(1)	(2.1)	(3.1)	(2.2)	(3.2)
		@Sum above		@Sum above	
TOTAL CHEMICALS		kg	(4.1)	(4.2)	kg
GAS LOSSES		kg	(5.1)	(5.2)	kg
NET CHEMICALS		(6.1)	kg	(6.2)	kg
Chemical costs		(7.1)	US \$	(7.2)	US \$
Formulation costs	US\$/kg	(9)		(10)	(8) cost difference US\$/kg
Production	metric tons	(11)		(11)	
Total chemical costs	(x1,000 US\$)	(12)		(13)	
BENEFITS / YEAR	(x1,000 US\$)			(14)	
Incremental maintenance		(15)			
Incremental Power		(16)			
LCD storage tank lease/year:		(17)			
Incremental yield loss/year:		(18)			

CONSOLIDATED INCREMENTAL OPERATIONAL COSTS/SAVINGS (1, 000 \$US)

COST ITEM	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
Chemical costs	(14)	(14)	(14)	(14)	
Incremental Maintenance	(15)	(15)	(15)	(15)	
Incremental Power	(16)	(16)	(16)	(16)	
Tank lease	(17)	(17)	(17)	(17)	
Incremental Yield losses	(18.1)	(18.2)	(18.3)	(18.3)	
I.O.C. (I.O.S)	(19)	(19)	(19)	(19)	
Discount factor	0.91	0.83	0.75	0.68	
N.P.V.	(20)	(20)	(20)	(20)	(21)
TOTAL INCREMENTAL OPERATIONAL COSTS/SAVINGS				(21)	\$U.S.

(1) See attached User Guide

(2) The template is available in microsoft excel version 5.0 and may be obtained from the Fund Secretariat, UNDP, UNIDO or the World Bank.

User Guide to the LCD Template

The following are explanations to the annotations in the template.

- (1) Raw material price
- (2.1) Formulation with CFC-11
- (2.2) Formulation with LCD
- (3.1) (1) multiplied by (2.1)
- (3.2) (1) multiplied by (2.2)
- (4.1) Sum (2.1)
- (4.2) Sum (2.2)
- (5.1) Gas Losses (CFC-11) = (2.44) multiplied by (% water consumption + % CFC consumption)
- (5.2) Gas Losses (LCD) = (2.44) multiplied by (% water consumption + % LCD consumption)
- (6.1) (4.1)-(5.1)
- (6.2) (4.2)-(5.2)
- (7.1) Sum of (3.1)
- (7.2) Sum of (3.2)
- (8) Difference between both formulation costs
- (9) (7.1) divided by (6.1)
- (10) (7.2) divided by (6.2)
- (11) Current production output in metric tonnes
- (12) (9) multiplied by (11)
- (13) (10) multiplied by (11)
- (14) (12)-(13)
- (15) Incremental maintenance cost to be taken as US\$12,000 - US\$18,000
- (16) Incremental power cost to be taken as US\$3,500 - US\$5,000
- (17) Tank Lease US\$4,500 - US\$5,000
- (18) Incremental yield loss to be taken as 4% for first year, 2% for the second year, and 0% for third and fourth years
- (18.1) (13) multiplied by 4%
- (18.2) (13) multiplied by 2%
- (18.3) (13) multiplied by 0%
- (19) Sum of 14 to 18
- (20) Multiplied by discount factor
- (21) Addition of all four years

I.O.C. Incremental Operational Cost

I.O.S. Incremental Operational Savings (IOS is indicated by parenthesis () or as negative figure

ANNEX II

FLEXIBLE POLYURETHANE FOAM (LCD) PROJECTS SUBMITTED TO THE 23RD MEETING OF THE EXECUTIVE COMMITTEE
FLEXIBLE SLABSTOCK (Cost-effectiveness Threshold US \$8.23/kg)

Country/Project	Implementing Agency	CFC-11 Tonnes	Incremental Capital Cost US\$	Incremental Operating Savings US\$	Project Cost US\$	Eligible Amount US\$	Cost Effectiveness
ALGERIA							
La Mousse du Sud	UNIDO	95	570,637	106,363	464,274	464,274	4.89
INDONESIA							
Sea Horse	WB	90	621,500	89,300	532,000	532,000	5.91
INOAC	WB	110	566,500	153,600	412,900	412,900	3.38
IRAN							
Mashhad Foam	UNIDO	90	558,987	60,513	468,474	468,474	5.21
MOROCCO							
Moussse d'Or S.A.	UNDP	45	619,140	35,100	584,040	280,350	6.23
Salidor	UNDP	48	617,600	56,300	561,300	299,000	6.23
Sodiflex	UNDP	85	619,800	102,500	517,300	517,300	6.08
SYRIA							
Akal Factory	UNIDO	101	649,500	(112,104)	537,396	537,396	5.32
TUNISIA							
Sud Inter Mousse	UNIDO	102	556,416	120,584	435,832	435,832	4.27
TURKEY							
Go-Ya Sungar	UNIDO	95	550,403	99,097	451,306	451,306	4.75
Isbir Termoset Plastic	UNIDO	130	509,982	139,518	370,464	370,464	2.85
Sefas	WB	93.83	621,500	91,500	530,000	530,000	5.85

FLEXIBLE MOLDED (Cost-effectiveness Threshold US \$16.86/kg)

MALAYSIA							
CT Foam	UNDP	14	209,000	7,175	201,825	201,825	14.42
Heng Haut Furniture	UNDP	50	209,000	27,750	181,250	181,250	3.63