OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

PROJECT PROPOSAL ...
IMPLEMENTATION OF THE MONTREAL PROTOCOL FINANCING

22073 2nd Proj. Doc 20p. tables diagrams PL

COUNTRY	: India	
PROJECT TITLE	: Conversion of precision cleaning & coating processes from ODS solvents to heat cleaning technologies and ODS free solvent coating at Malhotra Shaving Products Ltd., Hyderabad.	
PROJECT IMPACT	: Phase out annual consumption of 11 MT of trichlorotrifluoro ethane (8.8 ODP weighted MT).	
PROJECT DURATION	: 18 months	
PROJECT ECONOMIC LIFE	: 10 years	
TOTAL PROJECT COST	: Investment (Capital) costs	: US$ 486,470
	Incremental operating savings	: US$ 2,915
	Total Project costs	US $ 483,555
OWNERSHIP STRUCTURE	: 100 per cent Indian	
PROPOSED MF FINANCING	: US $ 483,555	
UNIT ABATEMENT COST	: US $ 7.11 per kg. ODS or US $ 8.89 per kg. ODP	
COUNTERPART ENTERPRISE	: Malhotra Shaving Products Ltd. Hyderabad	
IMPLEMENTING AGENCY	: UNIDO	
CO-ORDINATING MINISTRY	: Ministry of Environment & Forests.	

PROJECT SUMMARY

The project will phase out the use of 11 MT of trichlorotrifluorc ethane (CFC-113), at Malhotra Shaving Products Ltd. It has application on two processes (i) Blade cleaning process and (ii) Blade edge coating process. The cleaning process is used for thorough cleaning of razor blades to remove greases, oil, swaft, abrasive, wax, etc. The ODS solvent (CFC-113) is utilized as a degreasing agent in the three stages Degreaser. On Blade Coating Process CFC-113 is used as a carrier of PTFE material which is sprayed on the edges of Razor Blades under the Electrostatic charge.

The phase out of ozone depleting substances (ODSs) will b accomplished by replacing the solvent based cleaning methods with hea cleaning process and use of non ODS based (IPA) formulations of PTF and alternate solvent (IPA) for razor edge coating applications Country studies and the country programme prepared during 1992 hav identified the sector as a high priority area. Heat cleaning will b employed in place of ODS cleaning by the installation of new unit an an existing unit for coating of PTFE on the blade edges will b retrofilled to make it compatible with IPA. To avoid hazard, a automatic Fire Extinguishing system will be required.

AZ

CHAPTER I

PROJECT OBJECTIVE :

The objective of this project is to phase out the use of CFC-113 in the blade cleaning and spray coating processes at Malhotra Shaving Products Ltd. (MSP). These processes in which the ODS is utilised will be replaced with non-ODS solvents and techniques.

This is the second project formulated for the solvent based metal cleaning and coating sector in India. Considering the structure of the Indian Engineering Industry with special reference to blade manufacturing and steps required to phase out ODSs in metal cleaning and coating proceses, it is expected that this project will additionally identify and strengthen the oznone cell of the Ministry of Environment & Forest, New Delhi which will help to increase awareness in the selected metal industries in phasing out ODS. For this purpose the activities like collecting and compiling technical and technological informaiton, and to provide technical support regarding problems asscoiated with phasing out ODSs in the metal cleaning industry (blade manufacture) which include process development, materials compatibility testing, reliability testing and cost effectiveness analysis, technology selction and drawing up of equipment specifications etc. would be useful.

1.2 This project will provide assistance to small private companies involved in the production of razor blades in India. Therefore, this project can be considered as demonstration project for the metal cleaning and coating industry in India.

In co-operation with the Ministry of Environment and Forest, Electronics Trade & Technology (ET&T) of the Department of Electronics has been identified as the focal point. [1]

1. Electronics Trade & Technology Development Corporation Ltd. an enterprise of the Govt. of India under Deptt. of Electronics has been providing support to the Indian industry in the area of Technology Development, transfer of technology, Import of raw material & components and has experts in the field.

---

[1] ET&T is operating as a Government of India Enterprise under Deptt. of Electronics for implementing various programmes for the Govt. of India for commercial trading activities and transfer & upgradation of technology in the field of Electronics Industry.

CHAPTER - 2

SECTOR BACKGROUND

India became a signatory to Montreal Protocol in 1992 and as a part of subsequent exercise, a Country Programme document was prepared by the Government with the assistance of UNDOP. This document has assessed the Ozone Depleting Substances (ODS) consumption in the country and on the basis of this, a National Programme for the Phase-out of ODSs has been prepared to ensure the Phase-out of ODSs according to the national development strategy, without undoe burden to consumers and industry.

2.2 The solvents sector is the largest user of ozone depleting substances (ODS) in India. The size of consumption has been investigated in a number of studies. According to India Country Programme : August 1992, the total consumption of ODS in the country by 1991 was 10,370 tonnes equivalent to 13,111 tonnes ODP. Out of which, the solvent sector consumed 100 MT of CFC-12, 300 MT of CFC-113, 4,000 MT of carbontetrachloride and 550 MT of 1,1,1-trichloroethane (MCF), i.e. a total of 4,876 MT of ODP (ozone depletion potential)-weighted consumption, that is 36.6 per cent of total ODP-weighted consumption in India.

2.3 ODS consumption in the solvents industry is split between electronics, metal cleaning and other processes such as textiles, pharmaceuticals, pesticides, chlorinated rubber, etc. Cleaning processes used in the electronics industry consumed in 1991, 150 MT CFC-113, 75 MT CTC and 30 MT of MFC and included flux removal (printed circuit cards and hybrid circuits), semi-conductor manufacturing, microelectronic component cleaning, metal and plastic part cleaning and photoresist development and stripping. The use of ODSs in electronics cleaning in India has been increasing as a result of the devlopment of the electronics industry.

ODS consumption in India : As per the India Country Programme, the ODS & ODP figures for the year 1991 and unconstrained scenario by 2010 is given in the following Table-2, Exhibit-2 and Table-3 respectively.

Table-2
1991 Consumption

Types of ODS	All Sectors			Solvents		
	Actual MT	ODP-Weighted		Actual MT	ODP - Weighted	
		MT	%		MT	%
CFC-11	1900	1900	14.4	0	0	0.0
CFC-12	2850	2850	21.6	100	100	2.1
CFC-113	320	342	2.6	300	321	6.6
Sub-total	5070	5092	38. 6	400	421	9.7

Types of ODS	All Sectors			Solvents		
	Actual MT	ODP-Weighted		Actual MT	ODP - Weighted	
		MT	%		MT	%
Halon-1211	550	1650	12.5	0	0	0.0
Halon-1301	200	2000	15.1	0	0	0.0
Sub-total	750	3650	27.6	0	0	0.0
CTC	4000	4400	33.3	4000	4400	90.2
MCF	550	66	0.5	550	55	1.1
TOTAL	10370	13208	100.0	4950	4876	100.0

Sectoral Distribution

Aerosols	1100	1100	8.3
Forams	1580	1580	12.0
Refrigeration	1990	1990	15.1
Solvents	4950	4876	36.9
Halons	750	3662	27.7
TOTAL	10370	13208	100.0

The total ODS consumption as solvent in India in 1991 is given at Table-1.

Table-1

ODS Consumption in Solvent Sector

Sub-Sector	ODS	Qty.	ODP
Electronics	CFC-113	150	120
	CTC	80	88
	MCF	30	3
Textile cleaning	CTC	600	660

Sub-Sector	ODS	Qty.	ODP
Pharmaceuticals	CTS	1060	1160
Pesticides	CTS	800	880
Rubber industry	CTS	320	352
Chemicals & Laboratory	CTS	70	77
	MCF	50	5
Sterlization	CFC-113	10	8
	CFC-12	100	100
Metal & precision cleaning	CFC-113	130	104
	MCF	40	4
Miscellaneous uses	CFC-113	10	8
	CTC	1070	1177
	MCF	430	43
Sub total	CFC-12	100	100
	CFC-113	300	240
	CTC	4000	4400
	MCF	550	55

2.4 Subsequently to the finalisation of India Country Programme for ozone depleting phase out under Monteal Protocol and taking into consideration the structure and distribution of Indian Electronics Industry and lack of awareness, UNIDO in co-operation with Department of Electronics/ Centre for Materials for Electronics Technology formulated a programme under which 04 OD solvent phase out projects were worked out which have been approved by multilateral Fund for financial assistance. As a follow up to this programme, UNIDO in co-operation with Department of Electronics (DoE) / Electronics Technology Development & Trade (ET&T) has formulated a programme under which a few solvent phase out proposals can be worked out. ET&T is a commercial venture by DoE and involved in the manufacturing of electronics components & products and has got expertise and infrastructure to carry out such programmes in an efficient manner.

CHAPTER 3

ENTERPRISE BACKGROUND :

Malhotra Shaving Products Ltd. (MSP), a Company manufactures shaving razor blades, high-tech laser blades and shaving systems and disposables. The company has major manufacturing activity in Hyderabad, Andhra Pradesh.

Malhotra Shaving Products Ltd. was originally incorporated as a Pvt. Ltd. Company on 17th day of May, 1960 under the Companies Act. Subsequently the Company has been converted into a deemed public company in the year 1976 in terms of Section 43 A (2) of the Companines Act, 1956. The company whose name has been changed from Indo Swing Ltd. to Malhotra Shaving Products Ltd. on the 30th Day of July, 1992 has been one of the pioneers in the field of manufacture of safety razor blades and twin track shaving systems.

The history of the company dates back to the year 1959-60 when the Malhotras have acquired a sick unit which was then manufacturing the safety razor blades under the brand name of "Ashok". Over the years the company has grown multifold and manifold from a small capacity employing hardly 40 persons to a monopoly house with installed capacity of over 1000 million blades and actual production of around 900 million blades, employing about 700 workers in the manufacturing process. The company has added to its list of brand products the names of laser and gallant which have transcended the Company's operations beyond the national boundaries. The company has multiplied its turn-over in the last 3 decades and has achieved a turn over of Rs.52 crores as on 31st March, 1997 with an investment in fixed assets to the tune of Rs.22 crores.

Malhotra Shaving Products Measure upto the highest international standards of quality in terms of performance and safety at low price.

The plant was established in 1960 and it mostly produces high quality disposable razors and laser double edge blades of international standards. The current installed capacity of the plant is 1200 million pieces per year whereas the rated production per year is of the order of 1000 million pieces. The technology for the blade manufacturing was established by inhouse R&D and in consultation with foreign experts which includes strip perforation machine, heat treatment furnace, printing machine, edge sharpening machine, blade cleaning system, metal & polymer coating systems, blade sintering furnace, wrapping and packing machine, etc. For the system blades after sintering the blades are split into two and fed to the special purpose assembly machine wherein the blades are positioned for accepted shaving geometry with plastic components and aluminium spacers. Presently Malhotra Shaving Products has got a total of 960 manpower in the manufacturing side (skilled and non skilled) distributed in three shifts.

3.2 The production of razor blades and shaving systems by MSP during the last 03 years was as follows :-

Year	Double Edge	Twin Blade System	Total
1994-1995	581	135	716
1995-1996	616	163	779
1996-1997	592	195	787

3.3 The Hyderabad Plant of MSP is a pioneer of high-tech blade making in India. The company has developed world class levels of precision oriented manufacturing technology uitlising microprocessor controls & computerised equipments. The company obtained ISO 9002 certification.

3.4 The major razor blade manufacturing processes are blade strip perforating, hardening, tempering, blade strip sharpening, razor blade cleaning, edge coating, blade parting, and packing. Ozone Depleting Substances (ODS) are used as solvents in blade cleaning (degreasing) and edge coating processes. The plant is not divided into separate workshop, however cleaning and coating of razor blades are done in the separate rooms. The company has incorporated good house keeping, recovery and recyclying and as a result the consumption of ODS was brought down to 11 MT per annum.

Blade Cleaning Process :

3.5 A thorough blade cleaning was performed after blade edge sharpening at the degreaser with precision grade of high purity CFC-113 solvents (Freon). The sequence of operation is that the product (blades) are loaded on fixtures which pass through hot immersion chamber, high pressure spray nozzles, again hot immersion (IInd Chamber) and finally through hot distillate spray chamber (details at Appendix-1). The blade cleaning system with all the accessories was purchased from ICI, UK in 1980. The cost of the cleaning system was around Rs.15 lacs at that time. The cleaning was done in ultrasonic cleaner having 03 compartments with different temperature profile. In the first compartment the cleaning is carried out with the solvent by spraying at high pressure where the blades dipped in the solvent. Subsequent to this, the cleaning is performed in the Second compartment at elevated temperature and finally in the third compartment the cleaning is carried out with the help of vapours. The unit has got in-built heating arrangements as well as to condence the vapour at the top of the ultrasonic cleaner. The over all size of the ultrasonic cleaner is 2075 x 890 x 1360 mm, whereas the effective compartment size is 510 x 305 x 305 mm. This can keep a hold up of 250 liter of CFC-113. The connected load of this unit was 11.5 KW.

Blade Edge Coating Process

3.6 CFC-113 is used for diluting the polytetrafluoroethylene (PTFE) and as a pulverizing agent for PTFE on the blade. The Malhotra Shaving Products Ltd. was applying Vydax 1000 for coating razor blades. The vydax - 1000 is a 7.5% dispersion of fluorotelomer in freon which is further diluted with CFC-113 to give a suspension of solids containing 1 to 2 per cent before being applied to the

edges of the razor blade stack. Vydax-1000 and CFC-113 are later blended in the proportions of 1 to 99 by means of blending two chemicals in a mixer (a mixing tank with integral pump, stirrer mechanism, meter and inter-connecting plumbing) and later homogenizing the blend in a homogenizer (required to make vydax formulation). Vydax and CFC-113 were being imported from Du-Pont, USA. CFC-113 is also procured from local sources.

3.7 The mixture of freon with tertiary butyl alcohol (TBA) was the preferred choice of diluting the vydax-1000 for homogenisation and final spraying/coating. The mixture finally is taken into a homogenizer and mixed further at a pressure of 8000 PSI where the particle size get reduced from 30 microns to 1 micron. The blade are then finally spray coated. The ODS consumption in the cleaning and coating proesses in MSP unit was as follows :-

ODS-Annual Consumption during 1996-97

Process	Solvent	Consumption (Kgs.)	Unit cost CIF(US$/kg)	Annual cost US $
Blade Cleaning Unit	Freon TF	8,000	3.5	28,000
Blade Edge Coating	Freon	3,000	3.5	10,500

3.8 The list of equipments used for ODS based cleaning and coating at MSP unit alongwith specifications and purchase price are indicated below :-

ODS Solvent Equipment at Harbans Lal Malhotra & Sons

List of Equipments	Quantity/Detail	Price (FOB)
1) Ultrasonic Degreaser	1 No.	15 lacs
Manufacturers	ICI	
Cleaning Action	3 stages	
Solvent Chambers	3 Nos.	
Still unit	1 No.	
High Pressure Pumps	2 Nos.	
Solvent Vapor Recovery Unit	1 No.	
2) Blade Edge Coating System	2 Nos.	40 lacs
Manufactuers	Ransberg	
Quantity of Guns	2 Nos.	
Heat Zone, with Exhaust Fan,Transformer, etc.	2 Nos.	

List of Equipments	Quantity/Detail	Price (FOB)
3) Anccillary Equipment		Rs 35.0 lacs
Homogenizer	2 No	
Mixing tank	1 No	
Shaker	2 No	
Drying Chamber with Exhaust Fan.	1 No	

3.9 Soon after India signed Montreal Protocol for ozone depleting substances phase out, MSP were concerned about the ODS phase out in their razor blade plant. They started exploring the possible alternative and discussed with various agencies in India and abroad. On the basis of the information available and some R&D studies, they have decided to go in for heat cleaning in place of ODS cleaning and IPA based coating process. Now they have approached Department of Electronics (DoE) and Electronics Technology Development and Trade (ET&T) for helping them in prepartion of the project for ODS phase out and financial assistance from Multilateral Fund. The proejct has now been prepared incorporating the alternate technology using non-ODS solvent and worked out as per the guidelines of Montreal Protocol.

CHAPTER - 4

PROJECT DESCRIPTION :

The replacement of ODS in the blade manufacture require alternative processes with extensive engineering know how to carry out tasks such as reliability testing, material compatibility testing, quality consistency and process development, technology selection for alternative cleaning and coating system, site preparation, installation of machinery and staff training etc. This was carefully studied by Malhotra Shaving Products Ltd. and have selected a suitable technology as an alternate to the existing ODS technology. MSP also did some trial experiments on alternate processes inhouse and spent Rs.80 lacs.

Technology selection, equipment selection and purchase of alternative cleaning and coating machines.

4.2 Malhotra Shaving Pproducts Ltd. have put considerable efforts in identifying a suitable alternative from ODS to non ODS solvents/technology. It was found that the other chlorinated solvents, (trichloroethylene, perchloroethylene and methylene chloride), aqueous and semi-aqueous cleaning and cleaning with petroleum solvents, ketones and alcohol were found to be acceptable for new alternative technology to phase out the utilisation of ODSs in cleaning processes.

Cleaning process at Malhotra Shaving Products Ltd., Hyderabad

4.3 In the blade technology, the edge surfaces must be free from oil/grease/swaft and any other sort of contamination prior to applying protective coatings. Water will not be a suitable solvent for precision cleaning of razor blades. Hydrocarbons are still expensive. The best suitable solvents available in the market which could be tried are Trichloroethylene, Perchloroethylene, methylene chlororide, etc. which are non ozone depleting substances and have the least adverse effect on the ground product. Heat cleaning is another process which can produce compatible cleaning to solvent cleaning and has been proved to be an attractive technology. However, this require process standarisation and considerable efforts for adaptation of this technology in commercial application.

Alternative Blade Cleaning System :

4.4 Twin chamber vacuum purged furnaces for Heat cleaning and sintering of Razor Blade Stacks are required to meet the production capacity requirement of MSP for outstanding cleaning

results. Ammonia crackers are required to break ammonia into Hydrogen and Nitrogen. Hydrogen is burnt whereas Nitrogen is used as protective atmosphere which protect the blade for oxidation during heat cleaning. This alternate technology requires heat cleaning furnaces and accessories. There is high electric power consumption but no solvent or ozone depleting substances are used in this process. This cleaning process has been proved to be very successful as it has resulted into the product quality of international standard. The new heat cleaning system would cost Rs.152 lacs (US$ 415,000).

Alternative Blade Coating System :

4.5 The existing blade coating system was designed for Freon and tertiary butyl alcohol. The new blade coating system should have following mechanism and ancillary equipments i.e. a complete razor blade coating systems having a fully automatic spray facility and consisting of spray booth equipment, transport conveyor and all power fitting and disconnects. This also include a homogenizer which break the suspension particle size from 30 microns to 01 microns at a high pressure of about 8000 PSI. MSP have conducted studies in their R&D laboratory for an alternate coating process. The results are encouraging. The new technology incorporate the change of freon by IPA and TBA mixture. The drying chamber is also attached to vaporize IPA before the sintering process. It is now proposed to go in for either a new coating system or retrofitting of the existing coating system. The new coating material Krytox-1000 has a 20% dispersion of Fluorotelometer solids in IPA and TBA. The amount of Krytox-1000/IPA requirement for this plant per annum is same ($ 26,400) as against vydax- 1000 /CFC-113. The consumption of IPA (Dried IPA) is as follows :-

Estimated Consumption of Non-ODS Solvents (Dried IPA)

Description	Unit	Unit cost US $	Quantity	Cost/Year US $
Dried IPA	Lit	2.2	12,000	26,400

4.6 Ancillary new fire-proof equipments to be installed with thei main system are as under :-

1.	Homogenizer	1 No
2.	Shaker	1 No
3.	Drying chamber	1 No
4.	Fire extinguishing system	1 No

4.7 Due to flammable nature of IPA and ODS free coating solution, th personnel and the coating equipment needs to be properly protecte against fire hazards. This can be achieved through installation of a automatic fine water mist fire protection system, which allows t extinguish fires at much lower application rates than a conventiona water sprinkler system. This equipment is proposed to be installe in MSP, Hyderabad Plant. The cost of the equipment is around Rs.4. lacs (US$ 12,000).

Environmental aspects :

4.8 Under this project, the Hyderabad Plant of MSP is proposed to b converted to non-ODS cleaning and coating proesses which i technologically accepted world wide. Since the cleaning proces involve only heat treatment, no adverse implication to environment ar there during cleaning process while coating the blades, solvent lik IPA and TBA are used which have no adverse affect in the environment.

4.9 With regard to the condensed waste, all the contaminants can b easily removed and economically disposed off. No additional cost ar needed since the factory normally burns all the wastes.

Site Preparation and installation of Machinery :

4.10 The project includes funding to prepare the sites for th equipment installation. This is for electrical supply and plumbing t ensure safe installation of the equipment. Technical staff of th equipment supplier or their agents in India would help th installation work.

Staff Training :

4.11 The alternate cleaning would be heat cleaning & non-ODS coatin solvents would be used in place of CFC, the existing Engineers operators and maintenance personnel have to be trained in operatin the new systems at appropriate agencies.

Project Costs :

4.12 The project costs refers to all costs including incremental recurring costs. The cost of utilities and solvents may differ between project to project in the country. Annexure-I indicates the total project cost of US$ 483,555. The total project incremental cost of US $ 483,555 was calculated as the investment capital cost US $ 486,470 minus net incremental operating saving of US$ 2,915 for 04 years discounted at 10%.

Capital Investment Cost :

4.13 As given in Annexure-I, the total investment cost is US $ 486,470. The major components of this cost include the purchase, installation of heat cleaning system and retrofitting of Blade Coating Systems with necessary acillary equipments.

Incremental Operating Costs/Savings :

4.14 If the project was not undertaken, the annual operating cost could have been US $ 86,600. Once the project is implemented, the annual operating cost is US $ 85,680, resulting in annual operating saving of US $ 920. Given an equipment lifetime of 10 years and discount rate of 10% , the net value of the first 04 years of incremental operating savings is US $ 2,915. The details are provided in Annexure II.

Revenues :

4.15 This project provide to MSP Hyderabad with US$ 2,915 as annual incremental savings.

Local Ownership ratio :

4.16 Since the total project incremental cost should be multiplied by the fraction of local ownership i.e 100% to determine the proposed grant amount, so the total proposed mulitlateral fund financing is equal to total project incremental cost i.e. US $ 483,555.

Contingencies :

4.17 The calculations are based on the quotations received, no contangencies have been provided.

Unit Abatement cost (UAC) :

As in Annexure III, the UAC is US $ 8.89 per ODP weighted kilogram of ODS phased out per year. This number is derived from an annualised incremental cost of capital US $ 486,470 and first year incremental annual operating savings of US $ 920 and phasing out of 11 MT of CFC-113 (8.8 ODP tons) ODS per year.

Proposed MF Grant :

The proposed MF grant for this project was US $ 483,555 calculated below :

The total investment cost of US $ 486,470 was deducted with the net present value of the incremental operating costs over the first 04 years of the project which is US $ 2,915. The sum was then multiplied by the 100% Indian ownership ratio of MSP, Hyderabad yield the resultant grant of US $ 483,555.

MF Grant Calculation

Total investment cost US $	:	486,470
Incremental Operating costs over the first four years US $	:	(-) 2,915
Project preparation cost US $	:	-
Propsoed MF grnat US $	:	483,555

Financing Plan :

MF funding is a grant and is limited to the capital and incremental savings as calculated above.

Project Implementation :

The project will be carried out at MSP, Hyderabad in co-operation with Ozone Cell, Ministry of Environment and Forests, Government of India. UNIDO will also provide technical assistance to the project during its implementation.

Required Regularory Action :

No regulatory action, other than routine permitting are required to implement this project.

Direct Project Impacts :

The project will eliminated annually 11 MT of ODS (8.8 MT OD weighted) at MSP Hyderabad.

Annexure I

Breakdown of total investment (capital) cost.

Sl. No	Description of cost item	Unit	Unit cost US $	Qty.	Total cos US $
1.	Cleaning & coating equipment				
	Heat Cleaning System				
1.1	Heat cleaning furnaces with gas supply, pressure system and sintering.	ea	415,000	1	415,000
1.2	Retrofitting of coating unit with attachments.	ea	10,000	1	10,000
	ANCILLARY EQUIPMENT				
1.3	Ammonia cracker for gas generation for firing the furnaces.	ea		1	Availabl
1.4	Mixing tank with agitator	ea		1	Availabl
1.5	Drying Chamber	ea	4,100	1	4,100
1.6.	Homogenizer	ea	20,000	1	20,000
1.7	Exhaust Fan	ea		10	Available
1.8	Shaker	ea	1,370	1	1,370
1.9	Power supply	ea		1	Available
1.10	Water mist fire protection system	ea	12,000	1	12,000
1.10	Installation costs (Electrical, Piping, water, compressed gas supply, etc.)	ea	7,000	2	14,000
1.11	Training & Engineering material compatibility process developmen, reliability testing etc.	ea	10,000	-	10,000
	TOTAL				486,470

Note 1 US$ = Rs.36.50

Annuexure II

Breakdown of incremental cost/ savings

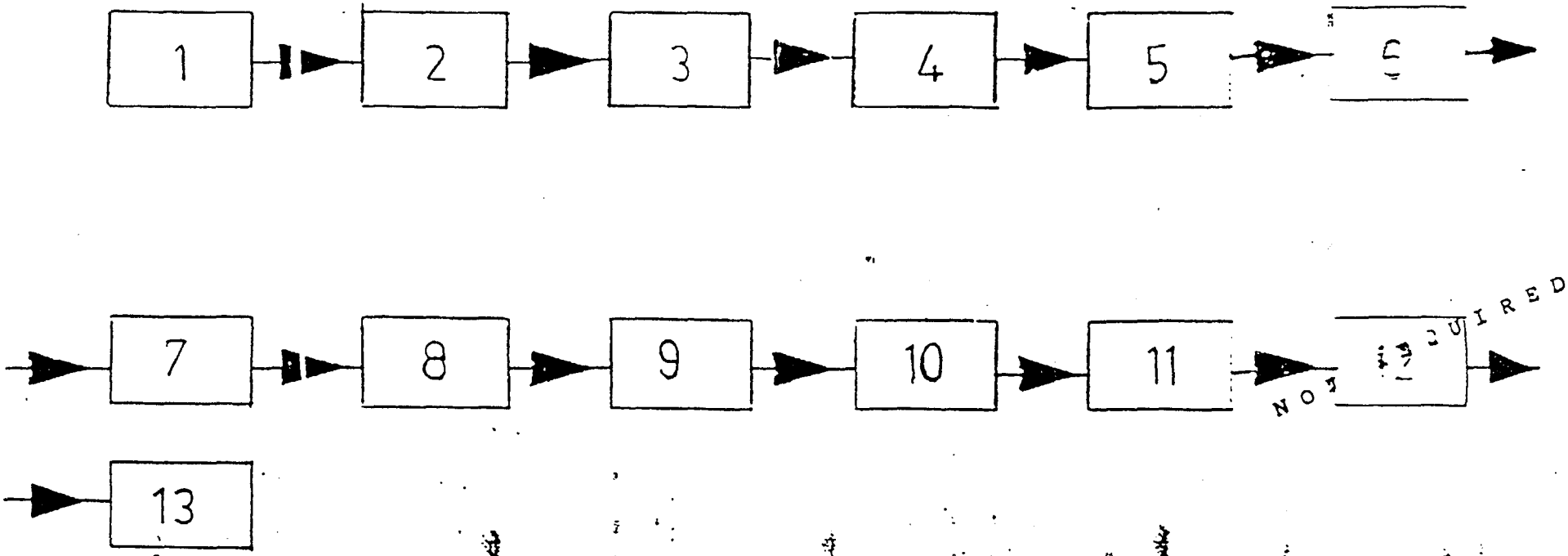
	Description of cost item	Unit	Unit cost US$	Qty.	Pre-project cost US$	Post Project cost US$
A.	Solvent/media cost per year					
A.1	CFC-113 (cleaning & coating)	Kg.	4.0	11,000	44,000	-
A.2	Vydax-1000	Kgs.	30.0	800	24,000	
A.3	Krytox-1000	Kgs.	30.0	800	-	24,000
A.4	IPA	Kgs.	2.2	30,000	-	26,400
	Sub Total				68,000	50,400
B.	Electricity cost per year					
B.1	Two systems (coating & cleaning)	KWH	0.10	81,000	8,100	-
B.2	Heat cleaning & IPA coating etc.	KWH	0.10	172,800	-	17,280
	Sub Total				8,100	17,280
C.	Labour costs					
C.1	Labour for cleaing (CFC) and coating system.	w/m	125	7	10,500	-
C.2	Labour for cleaing and coating system (ODS free)	w/m	125	12	-	18,000
	Sub Total				10,500	18,000
TOTAL					86,600	85,680
TOTAL POST PROJECT COST						(-) 920

Annexure III

Calculation of Unit-Abatement cost

A.	ODS Phase out		
A.1	Annual Consumption of CGC-113	mt	11.00
A.2	ODP of CFC-113		0.80
A.3	ODP	mt	8.80
B.	Annualised Capital Cost		
B.1	Total Investment cost from Annexure I	US$	486,470
B.2	Equipment Life	years	10
B.3	Discount rate	%	10
B.4	Annualised Capital cost B.1* 0.1627	US%	79,148
C.	Annual Incremental Operating Cost/Savings	US$	(-) 920
D.	Unit abatement cost		
D.1	Annualised Capital Cost per kg. ODS phased out (B.4/A.3 * 1000)	US$/Kg.	8.99
D.2	Annual incremental operating savings per kg. phased out (C/A 3 * 1000)		(-) 0.10
D.3	Unit Abatement Cost (D_1 + D_2)	US$/Kg	8.89

Manufacturing Flow Chart Of Single/Twin Track Cartridges.

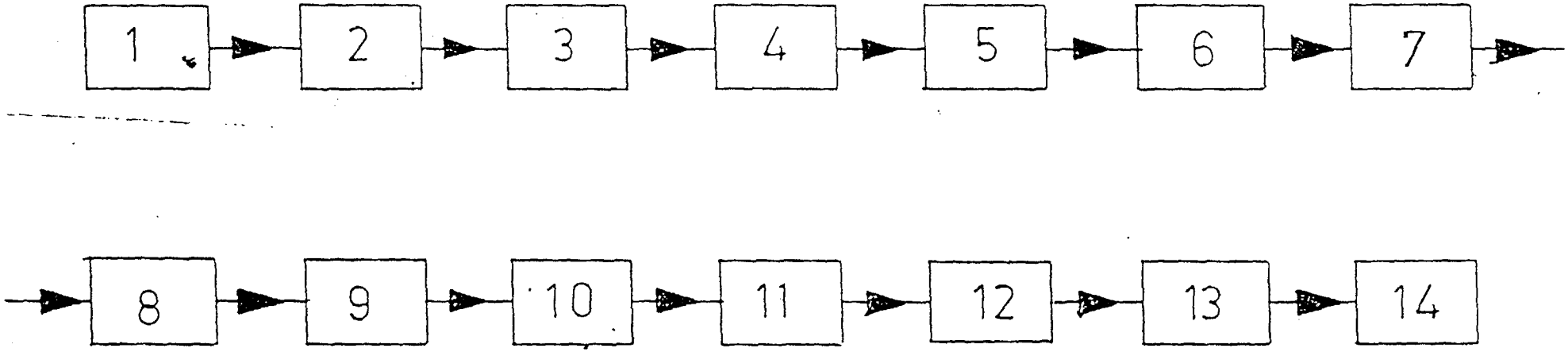


1. PUNCHING 2. HEAT TREATMENT 3. PASSIVATION 4. COIL JOINING 5. GRINDING 6. STROPPING 7. SPUTTERING

8. COATING 9. SINTERING 10. BLADE SPLITTING 11. ASSY. WITH TOPCAP & SEAT 12. PROTECTIVE COATING

13 PACKING

Manufacturing Flow Chart Of Stainless Double Edge Razor Blade



1. PUNCHING 2. HEAT TREATMENT 3. PASSIVATION 4. PRINTING 5. COIL JOINING 6. GRINDING 7. STROPPING

8. SPUTTERING 9. COATING 10. SINTERING 11. WRAPPING 12. CARTONING 13. CELLOPHANING 14. PACKING