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## Introduction

An optical fiber is made up of the core, (carries the light pulses), the cladding (reflects the light pulses back into the core) and the buffer coating (protects the core and cladding from moisture, damage, etc.). Together, all of this creates a fiber optic which can carry up to 10 million messages at any time using light pulses. Fiber optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher bandwidths (data rates) than other forms of communications. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference. Fibers are also used for illumination, and are wrapped in bundles so they can be used to carry images, thus allowing viewing in tight spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers[[1]](#footnote-2) Fiber optics are lines of thin glass or plastic that can send digital information by transmitting light signals. Optical fibers have the diameter of a human hair and are bundled up into optical cables. The fiber optic network is the next step in telecommunication network technology. Optical fiber is superior to the traditionally used copper wiring in essentially every category. The dominance of sending information using digital vs. voice technology also plays right to the capability of fiber optics. Fiber optics are being used most notably in telecommunications, but there use spreads to the medical, cable, defense, and engineering industries[[2]](#footnote-3).

|  |
| --- |
| Technical Feasibility |
| **2.1 Manufacturing Process** |

Manufacturing of Optic Fibre undergoes two stages:

1. Manufacture of Quartz Preform:

(i) Quartz preform manufacturing includes manufacture of the core and the cadding manufacture is done by the following process:

* Modified chemical vapour Deposition: - ultra pure chemicals - components -silicon tetra-chloride (SiCl4) and germanium terta-chloride (GeCl4) are vaporised in highly controlled environment and carried to the inside of a rotating glass tube made of pure synthetic silicon di oxide (SiO2). The pure silica tube is mounted on a lathe equipped with a special heat torch (using hydrogen and oxygen flame). As the gas mixture flows inside the tube they react to the heat by forming solid sub-micron particles, which is deposited on the inner valve of the tube. The material deposited in the tube will form the core region of the Optical Fibre. The process is repeated for many hours to lay down subsequent core layers.
* Vapour Axial Deposition: - ultra pure chemicals - components - silicon-tetra-chloride (SiCl4) and germanium tetra chloride (GeCl4) are vaporised in a highly controlled environment and carried to the bumers along with hydrogen and oxygen gases. In the flame, SiCl4 and GeCl4 oxides to form SiO2 and GeO2 which in return deposit to a starting seed rod in a form of white solid sub-micron power (soot). This deposition grows axially during several hours of operation and is sintered in clean chemical environment at a high temperature to consolidate and purify as crystalline structure- quartz.
* Outsider Vapour Deposition:-ultra pure chemicals - components - silicon-tetra-chloride (SiCl4) and germanium tetra chloride (GeCl4) are vaporised in a highly controlled environment and carried to the bumers along with hydrogen and oxygen gases. In the flame, SiCl4 and GeCl4 oxides to form SiO2 and GeO2 which in return deposit to the outside of a rotating quartz rod in a form of white solid sub-micron powder (soot). This deposition grows during the several hours of operation and is sintered in clean chemical environment at a high temperature to consolidate and purify as crystalline structure- quartz, the stating rod is pulled out and balanced is collapsed to make core.

(ii) Quartz preform is manufactured from the core / cladding gases material by using either off the two below mentioned cladding process.

* Plasma Chemical Vapoured Deposition: - ultra pure chemicals - components -silicon tetra-chloride (SiCl4) and germanium terta-chloride (GeCl4) are vaporised in highly controlled environment and carried to the inside of a rotating glass tube made of pure synthetic silicon di oxide (SiO2). The pure silica tube is mounted on a lathe equipped with a plasma torch. As the glasses mixture flows inside the tube they react due to the heat generated by forming solid sub-micron particles, which is deposited on the inner valve of the tube. The material deposited in the tube will form the core region of the Optical fibre. The process is repeated for many hours to lay down subsequent core layers.
* Sleeving is Done by the following Process:-
* Rod in tube technology: A quartz tube of appropriate cross sectional area is collapsed over the core rod
* Jacket vapour deposition: Similar to OVD process but the GeCl4 is not required.
* Solgel technology: this process is recently developed and used by Lucent technologies. Silica gel is consolidated over a core.

1. Drawing:

The manufactured preform is converted into a hair - thin fibre. This is done in an operation called Fibre draw. The preform is hung vertically on top of a tower. The tip of the preform is first lowered into a high purity graphite furnace. Pure gases are then injected into the furnace. The tip of the preform is then softened at high temperature of 19000c. Once the tip is soft gravity pulls the molten glob till it becomes molten strand. This strand is put through a series of drawing dies and the drawing process begins. The fibre is pulled by a tractor belt at the bottom of the draw tower, and then wound on winding drums. The preform is heated to the optimum temperature to achieve ideal drawing tension.

During the draw process, the diameter of the Fibre is controlled to 125 microns. A two layer protective coating is then applied to the fibre- a soft inner coating and a hard outer coating. This two parts protective jacket provides mechanical protection for handling, while also protecting the pristine surface of the Fibre from harsh environments. This coating is cured by Ultra-violet lamps. The drawing process is well automated and requires virtually no operator inter-section after the threading steps.

The drawn Fibre is then tested and measured to ensure it meets all the stringent requirements

## 

## PLANT SPECIFICATION & CAPACITY

|  |  |  |  |
| --- | --- | --- | --- |
|  | The equipment calculation is based on the general assumptions regarding downtimes and normal working practice relating to holidays, maintenance policy and planned plant shutdowns. The yield calculations are based on the Fibre specifications quoted in the Technology specification by the plant suppliers. | | |
| **MCVD** | | |
| Preform Capacity  Preform cycle time  Hours per year  Down time (10%)  Hour per years net  Annual capacity (unyielded) | Km  Hrs  Hrs  Hrs  Hrs  Km | 250  16  8,760  876  7,884  123,730 |
| **Vertical Sleeving Lathe** | | |
| Preform Capacity  Preform cycle time  Hours per year  Down time (10%)  Hour per years net  Annual capacity (unyielded) | Km  Hrs  Hrs  Hrs  Hrs  Km | 250  3  8,760  876  7,884  659,890 |
|  | | |

|  |  |  |
| --- | --- | --- |
| **Draw Tower** | | |
| Preform change time | Hrs | 0.75 |
| Draw speed | m/mm | 1,000 |
| Hours per year | Hrs | 8,760 |
| Down time(10%) | Hrs | 876 |
| Hours per year net | Hrs | 7,884 |
| Annual capacity (unyielded) | Km | 4,01,150 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Proof Tester** | | | |
|
| Machine speed | m/min | 1000 | |
| Cycle time inc. drum changes | Hrs | 5.58 | |
| (12.6 km nominal) |  |  | |
| Hours per year | Hrs | 8,760 | |
| Down time (10%) | Hrs | 876 | |
| Hours per year | Hrs | 7884 | |
| Rewind allowance | % | 5 | |
| Annual capacity (unyielded) | Km | 3,37,100 | |
|  | | | |
| **Yields** | | | |
| Multiplication factors (x100 = percent yield specification preform/ Fibre related to impact of each stage). It is expected that these capacities will be substantially exceed as operator competence and experience develops and in any case the guarantee figures are minimum. | | | |
| Period | 1 | 2 | 3 |
| MCVD | 0.87 | 0.9 | 0.96 |
| Sleeving | 0.95 | 0.97 | 0.99 |
| Draw | 0.9 | 0.95 | 0.97 |
| Proof test | 0.8 | 0.92 | 0.97 |
| Measurements | 0.8 | 0.85 | 0.9 |
| Overall yield | 0.476 | 0.649 | 0.805 |
| Grade 1 (of overall) | 0.5 | 0.8 | 0.9 |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **No of Machines** | | | |
|  | | | |
| MCVD | 6 | 6 | 6 |
| Sleeving | 1 | 1 | 1 |
| Draw | 2 | 2 | 2 |
| Proof test | 2 | 2 | 2 |
|  |  |  |  |
| MCVD | 3,53,420 | 4,81,472 | 5,97,474 |
| Sleeving | 3,61,092 | 4,75,525 | 5,53,213 |
| Draw | 4,62,125 | 5,96,029 | 6,79,396 |
| Proof Test | 4,31,488 | 5,27,224 | 5,88,577 |
|  | | | |
| **Capacity Summary (Km)** | | | |
| Total (Grades 1 & 2) | 3,53,420 | 4,75,525 | 5,53,213 |
| Grade 1 | 1,76,710 | 3,80,420 | 4,97,892 |
| Grade 2 | 1,76,710 | 95,105 | 55,321 |
|  | | | |
| Notes. | | | |
| I.                   It should be noted that in later years the number of MCVD machines is limiting the factory output. | | | |
| II.                Minimum usable fibre length is assumed as 2.2km. | | | |

## Marketing Feasibility

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| --- |
| It has become absolutely essential for any commercial and business set up to adopt faster medium of communication in the present day jet age. Historically, homes and offices have been linked through copper wire cables, which can carry data and conversions. With the growth in communication network, the inter-link between the various components of communication has become so fast that the present system is getting heavily overloaded. Further the technology of copper wire cables could not transmit video images of acceptable quality. The information bandwidth of the conventional communication system using copper wire is being found more and more inadequate. The past challenges in the field have brought about a total rethinking on the technology and as a result of intense research; the communication system through Optical Fibre has come to be accepted as the perfect substitute to be the future communication system replacing the existing conventional system. |
| In addition to the advantage of having extra information bandwidth, Optical fibre communication system has many more advantages, a few of which are listed below:-   * Extra advantages of being light in weight and small in size, particularly in the underwater cables. * No possibility of internal noise and cross talk generation along with the immunity to ancient electrical noise, ringing, echoes or electromagnetic interference. * No hazards of short circuits as in metal wires * No problem when used in explosive environments * Immunity to adverse temperature and moisture conditions * Lower cost of cables per unit length compared to that of metal counterpart. * Very nominal shipping, handling and installation costs and * Lesser problems in space applications such as space radiation shielding and line data isolations.   Because of these advantages, fibre Optic communication is being currently utilised in telephones such as loops, trunks, terminals and exchange, etc., computers, cables television, space vehicles, avionics, ships, submarine cables, and special tethers, security and alarm system, electronic instrumentation system, satellite ground stations and industrial automation and process controls.  The Global telecom industry is moving towards Deregulation / Privatisation. The World Trade Organisation (WTO) accord signed in February 1997 by 69 member countries represented a significant move towards opening markets worldwide. It is expected that by 2002, the top 20 telecom markets worldwide will be 100% accessible to non-domestic companies. The deregulation process is in turn making way for international alliances across borders and is aiding competitiveness, thereby enlarging services for consumers and reducing costs. It is projected that with some of the technologies under development, a call to USA would cost only one cent. (Source Economic Times dated 27th March 2000)  Worldwide installation of Optical Fibre Cable, by geographical segments is as under |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Region/Year | 1998 | 1999 | 2001 | 2002 | 2004 | | International Undersea | 0.8 | 1.4 | 1.8 | 1.9 | 2.1 | | Developing Markets | 3.5 | 4.8 | 5.3 | 5.8 | 7.4 | | Asia-Pacific | 15.5 | 18.2 | 29 | 35.9 | 47.8 | | Eastern Europe | 1.6 | 2.4 | 3.9 | 4.7 | 6.2 | | Western Europe | 6.5 | 14.1 | 13.1 | 13.1 | 13.5 | | North America | 17.1 | 21.9 | 25.2 | 25.9 | 28.5 | |

KMI, USA predicts the global markets to grow by 12.5% p.a. with demand growth from third world countries estimated to be 4-5 times the demand growth from the developed world, primarily because the developing nations are not at near saturation telephone density, which is the case with the developed markets.

Currently, the indigenous capacities for manufacture of Optic fibre cable in the country are reproduced below:

|  |  |
| --- | --- |
| Name of Companies | Capacity In Ckm / Annum |
| Akash Optic Fibre Ltd. | 33000 |
| CMI Ltd. | 17100 |
| Sterlite Industries | 23647 |
| RPG Cables | 17000 |
| Sudarshan Telecom | 12000 |
| Himachal Futuristic Communication | 11000 |
| Birla Ericsson Optical | 10710 |
| Lucent Technology Finolex Ltd. | 10500 |
| Gujarat Optical Communication | 10080 |
| ARM Ltd. | 9792 |
| Uniflex Cables | 9180 |
| BWL Ltd. | 8570 |
| HCL Naini | 5650 |
| Optel Telecom | 4500 |
| Surana Telecom | 4000 |
| HCL Ltd. | 700 |

Global Players in Optic Fibres: Some of the major global players in the field of Optic Fibre are as follows:

* Corning Inc.
* Lucent technology Inc. (LU)
* Alcatle Alsthom Inc. (ALA)
* Fujikura Asia Ltd.,
* Sumitomo Electric Light wave Corporation,
* Furukawa Electric Company Ltd.

Globally, OF (with OFC prices moving) prices have literally been on roller-coaster. Spurred by sharp rise in demand, Of prices recovered from low of $25-30 per fibre kilometre (fkm) in early 1999 to $35-40 per fkm in April 2000. They steadily rose to $55-60 in October 2000 to $80-90 per fkm in March 2001. But since then the prices have stabilised and are now believed to be at $40-45 per fkm. It is expected that the company would be able to produce and market its products in this range comfortably without any market constraint whatsoever.

## 

## PROJECT COST ESTIMATES & MEANS OF FINANCING

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| --- |
| 5.1 COST OF THE PROJECT |
| The cost of the project has been estimated on the basis of the unit having an installed capacity for manufacture of 500000 RKM per annum of Optic Fibre on triple shift operation basis assuming 300 working days in a year. The cost of the project, including margin money for working capital, has been estimated at Rs. 20300 Lacs, |
|  |
| 5.2 LAND AND SITE DEVELOPMENT |
| Industrial land admeasuring 67000 Sq. mtrs is estimated to be required. |
|  |
| 5.3 BUILDING & CIVIL WORKS |
| Plans for the requisite factory building as per collaborators' specification along with auxiliary facilities have been drawn up. Step for construction are being taken up. The estimated the cost of proposed factory Building & Civil works is 800 Lacs. |
|  |
| 5.4 PLANT & MACHINERY AND UTILITIES |
| It is proposed to procure the plant & machinery required for the project from Watson Machinery International, U.S.A. The machinery requirement and the detailed cost thereof have been worked out at Rs. 15464 lacs including erection materials and charges. The expenditure on Water Installations, Workshop Equipment and Electrical Panes, Cables, Switches etc. is estimated to cost Rs. 1140 Lacs, thereby totalling to Rs. 16604 Lacs. |
|  |
| 5.5 MISC. FIXED ASSETS |
| It is estimated that proposed unit would have additional expenditure of Rs.300 Lacs under this head for the vehicles, furniture, and fixtures, computers, office equipments and auxiliaries. |
|  |
| 5.6 CONTINGENCY AND ESCALATION |
| This has been estimated @ 5% over the cost of Land & Site Development, Building & Civil Works, Plant & Machineries and Misc. Fixed Assets, amounting to Rs. 900 Lacs, to provide safeguard against price escalation or any other unforeseen expenditure and duly provided for in capital cost estimates. |
| 5.7 PRE-OPERATIVE EXPENSES |
| An expenditure of Rs. 800 Lacs has been earmarked on this account. The major expenditure will be on account of interest during construction period, which would be about Rs. 300 Lacs. Further, the consultancy fees / charges for the preparation of project report, Establishment / administrative overheads, Insurance, Travelling and Statutory fees and loan processing fees would be around Rs. 500 Lacs. |
|  |
| |  | | --- | | 5.8 MARGIN MONEY FOR WORKING CAPITAL | | The margin money for working capital in respect of the Proposed Project has been calculated on the assumption of bank finance being available towards working capital requirement to the extent of 75% in respect of inventories and receivables. The margin money requirement during the 1st year of operation has been estimated at Rs. 562 lacs on the basis of 70% capacity utilisation. Accordingly, the margin money requirement including operating expenses for 1 month aggregating to Rs. 600 lacs has been provided for in the project cost estimates. | |
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|  |
| Sources of Financing |
| 6.1 PROMOTERS' CONTRIBUTION |
| The company proposes to meet its share of the required contribution amounting to Rs. 6800 Lacs, which works out to 33.5% of the project cost and affords a margin on security of 28.6% in favour of the Financial Institution, partly out of share capital of Rs. 5600 Lacs and Unsecured Loans in the form of Quasi Equity amounting to Rs. 1200 Lacs.   |  | | --- | | 6.2 TERM LOAN | | The term loan of Rs. 13500 Lacs is envisaged to be obtained from Bank(s) / Financial Institution(s) on their usual lending norms. It is proposed to repay the Term Loan in 15 half-yearly instalments of Rs. 900 Lacs each, such instalments to commence after a moratorium period of 6 months from start of commercial production. Thus, the term loan is expected to be fully repaid within a period of 8 years from the date of disbursement of loan | |
|  |
|  |
| 6.3 DEBT EQUITY RATIO |
| Based on the above financing pattern, the Debt-Equity Ratio of the project works out to 1.99:1, which is quite reasonable considering the capital-intensive nature of project. |
|  |
|  |
| Working Capital Requirement The working capital requirement of the company is based on various components viz. Raw Materials, Work in Process, Finished Goods, Consumables and Receivables besides unpaid level of stocks, which have been taken on the basis of usual norms. |
| The installed capacity of the Optic Fibre Unit is assessed at 500000 RKM based on various techno-economic aspects. The product mix is based on the company's own assessment of the market for various range of Optic Fibre at present juncture and is considered quite realistic and market driven. While the company expects to achieve 70% capacity utilisation in the very first year of operation based on current market trends, the same is likely to go upto 80% in 2nd year and 90% in 3rd year onwards, which have been adopted for the sake of profitability projections and considered achievable. |
|
| In assessing the cost of production, the various cost component taken into account are cost of Raw Materials, Personnel Expenses, Power and Fuel, Repairs & Maintenance, Manufacturing expenses, Selling & Distribution expenses, Administrative & General expenses, Depreciation, Interest on term loans, unsecured loans and working capital loans. |
|
| 7.1 RAW MATERIALS |
| After considering the requisite inventory levels and the consumption parameters, the cost of raw materials has been worked out at Rs. 4133 lacs at 70% capacity utilisation in the 1st year of operation after providing for process losses and wastage, and the cost is estimated to vary in the same proportion at other capacity utilisation levels.   |  | | --- | | **7.2 PERSONNEL EXPENSES** | | Based on the analysis of cost trends in the similar industry / sector, the total employment cost (including perquisites and allowances) has been estimated at Rs. 207 Lacs for the proposed Optic Fibre unit during the Ist year of operation. An increase of 5% in employment cost has been assumed during the subsequent years to provide for increments etc. | | | |
|  |
|  |
| 7.3 POWER AND FUEL |
| The power requirement of the proposed unit is based on the analysis of the similar industry in this sector, and the cost thereof during the first year of operation is estimated at Rs. 331 lacs at 70% capacity utilisation level. The cost of this input at different capacity utlilisation levels after the commercial production of the Unit is likely to vary in the same proportion from II year of operation onwards. |
|  |
| 7.4 OTHER MANUFACTURING EXPENSES |
| The expenditure on repairs & maintenance as well as other manufacturing overheads is likely to be proportional to the capacity utilisation during various years in relation to the expenditure of Rs. 83 lacs during the first year of operation. |
|  |
| 7.5 ADMINISTRATIVE & GENERAL EXPANSES |
| Expenditure under this head include Printing & Stationery, Postage & Telephones, Rent, Rates and Taxes, Insurance, Professional fees, Travelling and Conveyance and other sundry expenses. Based on estimated expenditure of Rs. 196 lacs during first year of operation, an increase of 5% has been envisaged during the second year and 5% thereafter for the sake of profitability projections. |
|  |
|  |
| 7.6 SELLING & DISTRIBUTION EXPENSES |
| This has been provided @ 1% on the Gross Sales Value to take care of Advertisement, Publicity, Distribution & Sales promotion Expenses. |
|  |
|  |
| 7.7 INTEREST ON TERM LOAN |
| The interest on the proposed term loan of Rs.13500 Lacs for the proposed project has been provided @ 12% p.a. being the applicable rate of interest on the term loan. 7.8 INTEREST ON WORKING CAPITAL BORROWINGS |
| The working capital borrowing of the proposed unit is estimated during the first year of operation at Rs.1500Lac, going upto Rs.1600 Lacs during the 2nd year and to Rs. 1700 Lacs during the 3rd year onwards. The interest on the proposed working capital borrowing for the project has been provided @ 12% being the applicable rate of interest on such borrowings |
| 7.9 INTEREST ON UNSECURED LOANS |
| The interest on Unsecured Loans to be availed by the company has been provided for @ 12% p.a. in the profitability projections till its repayment. |
|  |
| 7.10 DEPRECIATION |
| In calculating the cost of production, Depreciation has been calculated under Straight Line Method after absorbing the preoperative expenses and contingency provision. However, for IT purposes, Depreciation has been provided for under WDV method. |
|  |
| 7.11 SALES REALISATION |
| For the purpose of profitability appraisal, the production, net of stock adjustment, is estimated to be sold at the prevailing market prices. The selling prices for various products have been taken in line with prevalent price of similar products, and the realisation levels are likely to improve in due course. Provision for excise duty has been made at applicable rates after considering Modvat credit available in respect of inputs. |
|  |
| 7.12 INCOME TAX |
| The tax rate has been assumed at 35% (excluding surcharge) on taxable income as per rates in force and the unit is expected to pay normal income tax from the 3rd year onwards. However, in view of the provisions of section 115JB of the I. T. Act, 1961 in respect of Minimum Alternate Tax, the company will be liable to pay MAT @ 7.5% plus surcharge for the first & second year of operation also.   |  | | --- | | 7.13 INTERNAL ACCRUALS | | The Net profit after tax with depreciation added back would make up sufficient internal accruals to provide for reasonable returns to the shareholders in the form of Dividends | | | |

|  |  |
| --- | --- |
| PROJECTED FINANCIAL POSITION | |
| As reflected in the Cash Flow Statement, the generation of funds by the operations would leave sufficient surplus after meeting the Term loan repayment obligations to meet capital expenditure requirements for the current as well as additional investments in future. Due provision has also been made for taxation and dividend payments out of cash generations in the respective years. The liquidity position of the unit is quite comfortable as reflected in build up of Cash & Bank Balances over the years. | |
| The Projected Balance Sheet of the Company has been shown for 8 operational years duly considering all the financial aspect of the proposed project including additional capital investment besides exposure to current assets and current liabilities. The unsecured loans raised by the company are not proposed to be withdrawn during the currency of the bank borrowings. The analysis of Projected Balance Sheet reveals growing Net Working Capital levels year after year, besides comfortable levels of Current Ratio and Debt Equity Ratio over the period of repayment of term loan, which is quite satisfactory from financial soundness point of view. | |
|  | |
| 8.1 FINANCIAL ANALYSIS | |
| The following statements have been further prepared to appraise the financial soundness of the project: | |
|   Debt Service Coverage Ratio: |
| The DSCR has been worked out with an average of 2.00, which is considered quite adequate to meet the repayment and interest obligation in respect of the proposed term loan of Rs. 13500 Lacs. |
|   Break Even Analysis: |
| The Break Even Point after the start of commercial production of the proposed project has been worked out at 45% which will be reached in the very first year of its operations. The Cash BEP is still lower at 20% only, which is considered highly satisfactory. |  |
|   Pay Back Period: |
| The Pay Back Period of the project is quite reasonable at 3 years 8 months, particularly in view of the capital-intensive nature of the project. |
| * The Internal Rate of Return has been worked out at a reasonable level of 21% which depicts a sound and satisfactory financial position of the proposed Optical Fibre Project. |

1. <http://www.123seminarsonly.com> [↑](#footnote-ref-2)
2. <http://www.123seminarsonly.com> [↑](#footnote-ref-3)