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Optical cable fiber industry- An Indian perspective

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ABSTRACT

Due to its increased bandwidth and ability to transmit messages over longer distances, optical fibres are reshaping the Indian telecom industry. The market for optical cable fibres is expanding due to the demand for quick and better networks. Due to the new normal, there has been an increase in Fiber to Home (FTTH) access. Due to their faster transmission speed and lower loss, optical fibre is becoming more and more necessary in the office and telecom sectors. Additionally, they have great EMI resistivity, which makes them perfect for usage in hostile environments. Numerous industries, with the telecommunication industry being the most prevalent user, use fibre optic technology, including the military, telecommunication, medical, etc. The market for optical fibre cables (OFC) in India was worth \$881.5 million in 2019 and is anticipated to increase at a CAGR of 19.7% to reach \$2.1 billion by 2024. It is hoped that government initiatives like the Smart City Initiative and Digital India will accelerate the progress of the industry.

Keywords: Bandwidth, Transmission, Propagate, Cladding, Patent, Telecommunication, Pliable, Quantitative

1. OBJECTIVES

- 1) To study the application of optical fiber in daily routine.
- 2) To understand the functioning of optical cable manufacturing companies in India.
- 3) To analyse the scope of the optical cable fiber industry.
- 4) To evaluate the advancement of technology supported by optical fiber in future.

Introduction

The technology known as optical fiber involves sending short light pulses over a long fiber, often constructed of glass or plastic, to transmit data. Signals move more safely along metal wires, which are chosen for transmission in optical fiber communication. Additionally immune to electromagnetic interference are optical fibers. The fiber optical cable applies total internal reflection to its use. Depending on the required power and transmission distance, the fibers are made in a way that makes it easier for light to propagate alongside an optical fiber. While multimode fiber is used for transmission over shorter distances, single-mode fiber is employed for long-distance transmission. These fibers' outer covering needs higher defence than metal wires can provide. An optical fiber's core and cladding are both constructed of extremely pure silica glass. One of two processes can be used to create an optical fiber from silicon dioxide. The first technique, known as the crucible method, involves melting silica powder, creating thicker, multimode fibers ideal for short-distance transmission of a variety of light wave signals. The second method, known as vapour deposition, produces a solid cylinder of core and cladding material that is later heated and pulled into a single-mode fiber that is thinner and designed for long-distance transmission.

Uses

Used in: industries, medical, defence purposes, communication, broadcasting, lighting and decorations, and mechanical inspections.

- Medical industry (lasers during surgery, endoscopy, microscopy, and biomedical research)
- Communication (networking fields and increases the speed and accuracy of the transmission data, hence used to for transmission and receiving purposes)
- Defence (wirings in aircrafts, hydrophones for SONARs and Seismic applications)
- Broadcasting (wiring for HDTV, CATV, video-on-demand and many applications)
- Lightening and Decorations (easy way to illuminate the area while being attractive and economical at the same time)

Industry

India

Sterlite Technologies Limited, Himachal Futuristic Communications Ltd., Aksh OptiFiber Limited, Finolex Cables Limited, Birla Cables Limited, Vindhya Telelinks Limited, UM Cables Limited, Uniflex Cables Limited, West Coast Optilinks, Paramount Communications Limited, etc. are a few of the major players in the Indian OFC market. With no monopoly known to exist within the OFC market in India. No monopoly exists in India

Major Players:

- Aksh Optifiber
- Golkonda Engineering Enterprises
- Birla Cable
- HFCL

World

- Sterlite Technologies Limited (Worldwide)
- Hengtong Optic-Electric Co Ltd (China)

History

John Tyndall's work from three decades earlier served as the foundation for the first real fiber optical cable, which was created in 1952 by scientist Narinder Singh Kapany of the UK. Thirteen years later, in 1965, two British research scientists named Charles Kao and George Hockman who were working with Standard Telephones and Cables realised that manufacturing defects were the reason fiber optics attenuated. German physicist Manfred Börner showed the first functional fiber-optic data transmission system at Telefunken Research Labs in Ulm in 1965. The following year, Börner filed the first patent application for this technology. NASA deployed television cameras to the moon in 1968 using fiber optic technology. Optical Fiber deployment in India began in 1990, although there was no local manufacturer at the time. It was necessary to import enough optical fiber to satisfy the whole demand. The Indian Industry is regulated by the Telecom Regulatory Authority of India, as due to the tremendous demand, the telecommunications sector is the primary user of optical fiber technology.

Significance of Optical Fibers

Compared to metal cables, fiber optic cables offer a substantially higher bandwidth. Fiber optic cables provide a substantial advantage over other transmission medium in terms of the amount of information that can be transmitted in a given amount of time. Fiber optic networks, with options ranging from 5 Mbps to 100 Gbps, are much quicker than even the highest-speed copper Internet connections. Fiber is pliable, bendable, and resistant to the majority of corrosive substances that frequently damage copper wires. Fiber optic cables are more lightweight and thinner than copper cables. Compared to copper, fiber is more resistant to breakage and damage and can handle higher draw pressure.

Few Leading Indian Companies

Aksh Optifiber (BSNL, VSNL, MTNL, Railways, Defence etc.)

Year	Revenue	Profit/Loss for the period
Mar 22	307.45 Cr	17.02 Cr
Mar 21	252.79 Cr	2.23 Cr
Mar 20	255.14 Cr	-247.73 Cr

HFCL (BSNL, MTNL, TTL, Reliance, Bharti, PGCIL, GAIL and VSNL)

Year	Revenue	Profit/Loss for the period
Mar 22	4330.27 Cr	282.78 Cr
Mar 21	4139.09 Cr	222.86 Cr
Mar 20	3658.24 Cr	203.82 Cr

Birla Cable (Idea, Videocon, HFCL, Huawei, etc.)

Year	Revenue	Profit/Loss for the period
Mar 22	538.14 Cr	21.74 Cr
Mar 21	330.36 Cr	8.20 Cr
Mar 20	225.33 Cr	1.02 Cr

Scope

In 2019, the market for optical fiber cables (OFC) in India was valued at \$ 881.5 million. By 2024, it is expected to have grown at a CAGR of 19.7 percent to reach \$ 2.1 billion. The Indian government's increasing investments in OFC network infrastructure are driving the market's growth. This is in line with government initiatives like the Smart Cities Vision and Digital India, which aim to boost internet coverage throughout the nation. Additionally, rising mobile device usage, increased FTTH (Fiber to the Home) connectivity adoption, and an increase in the number of data centres are all predicted to drive the optical fiber cables market in India during the ensuing years.

Regionally, the market for optical fiber cables in India is growing and spreading to other parts of the nation. However, due to the presence of large IT companies and an increase in the number of small and medium-sized enterprises (SMEs) in the region, the south is predicted to develop at the greatest CAGR throughout the forecast period. In 2018, the West dominated the Indian optical fiber cables market.

Challenges

Indian optical fibre industry is under the threat of global predatory trade practices. Often Chinese manufacturers dump low quality fibre at predatory prices in the Indian market. Advanced countries do not accept Chinese low quality fibre hence they dump into India and Africa. Usage of substandard optic fibre by Indian manufacturers to convert them into finished optical fibre will lead to poor quality of communication networks in India leading to need of more electronics to compensate for higher attenuation making it more expensive. A network built with subpar fibre optics will also have a shorter asset life, raising the total cost of ownership for such subpar networks using imported components. Additionally, it will harm the domestic optical fibre manufacturing ecosystems, which at the moment support 40,000 direct and indirect jobs, including high-paying jobs in photonics and precision engineering.

2. REVIEW OF LITERATURE

“Fiber Optics Communication: An Overview” - Prachi Sharma, Suraj Pardeshi, Rohit Arora, Mandeep Singh. International Journal of Emerging Technology and Advanced Engineering (IJETAEE). May 2013, Volume 3, Issue 5, ISSN: 2250-2459. The report provides a summary of the advancements in fiber optic communication. For various applications involving information transfer, optical fibers can be employed as a flexible transmission medium. Single-mode fiber can be utilised for longer lengths up to 100 km and multimode fiber for shorter distances up to 6 km since single-mode fiber has lower signal attenuation than multimode. As optical sources, LED and LASER has been discussed. Since it may be used with both SMF and MMF, the latter is recommended. In terms of bandwidth, signal security, electrical interference, size, and weight, fiber optic communication has advantages over copper wire-based communication. In India, using fiber optic communication for DAS for satellite, communication, and military applications has enormous potential.

“Concept Paper on Optical Fiber and Cable in Indian Telecom Network” - Telecommunication Engineering Centre Department of Telecommunications Ministry of Communications Government of India. November 2021, TEC 02008:2021. First, we would like to express our gratitude to the numerous scientists and engineers that worked on the optical fiber technology and related technologies to advance society to this point. The globe has seen the laying of incredibly long lengths of fiber. We could wrap the world in them twenty-five thousand times. As of September 2019, 2.68 million route KM of OFC were in use in India. The fiber has performed to our delight, to the best of it. In the Pune-Mumbai BSNL route, a single fiber carries traffic at a rate of 436.26 Gbps out of an installed capacity of 800 Gbps, and the route is operating without any issues.

“Atmanirbhar India needs to nurture its infra-tech progress in optical fiber” - Jaijit Bhattacharya, president of Centre for Digital Economic Policy Research (C-Dep). ET Telecom from Economic Times. June 15, 2022, at 8:13 am IST. India produces 100 million fiber kilometres annually, or about 100 times the amount needed to relay all of the current underwater fiber. Domestic yearly fiber optic consumption is less than half of our manufacturing capacity, at 46 million fiber kilometres, compared to our capacity to produce (FKM). Over 100 nations have received annual shipments of 16 million FKM of optical fiber in the last three years.

“Recent Research and Development of Optical Fiber Monitoring in Communication Systems” - Kunihiko TOGE and Fumihiko ITO*. Photonic Sensors (2013) Vol. 3, No. 4: 304-313. DOI: 10.1007/s13320-013-0127-2. There was a review of current optical fiber monitoring research and development. A potential technology that enables operators to maintain numerous facilities is optical reflectometry. There is no question that the primary technology for the present optical fiber monitoring in communication systems is the straightforward OTDR (or C-OTDR) approaches. As communication systems advance, however, the diagnosis of issues will grow more complex and call for various operations including optical access, trunk, and submarine architectures and applications. In order to provide highly dependable optical services, it is anticipated that optical fiber monitoring technologies would continue to be researched and developed.

“Research on The Current Situation and Development Trend of Optical Fiber Communication technology” - Bingjie Yuan, Han Cai. Journal of Physics Conference Series 1873(1):012013. DOI: 10.1088/1742-6596/1/012013. April 2021. The ideas and traits of optical fiber communication technology are briefly introduced in this work. Once readers have a basic understanding of this technology, this paper quickly evaluates how it is used in a few different industries before outlining its predicted future development trend. Future global information infrastructure will be supported by an important pillar in the rapidly evolving field of optical fiber communication.

“Optical Fiber: The New Era of High Speed Communication (Technology, Advantages and Future Aspects) - Arun Gangwar, Bhawana Sharma. International Journal of Engineering Research and Development. Volume 4, Issue 2 (October

2012), PP. 19-23. The basic model and types of optical fiber communication systems are covered in detail in this study. The utilisation of technology is then discussed, along with how it differs from the conventional electrical transmission method. It talks about the benefits and different restrictions of optical fiber communication systems. Finally, it displays every potential future development that will hit the market, some of which have already passed their prime while others are still being used for general research and development.

“Fiber Optical Communications” Lecturer Notes - Mrs Anitha Patibandla, Associate Professor, Mr M.Anantha Gupta, Assistant Professor, Ms M.Nagma, Assistant Professor. Malla Reddy College of Engineering and Technology. 2019-2020. This paper talks about the overall history, manufacturing process and real-life use of optical fiber cables. Along with that it also discusses the working of an optical fiber cable and the applications of all the branches of sciences involved in this.

3. RESEARCH METHODOLOGY

Exploratory research is undertaken to explore an area where there is less information or to investigate the possibilities of undertaking a particular research study. Quantitative research deals with data which can be expressed numerically and is used for the collection of data from a small sample. Therefore, the type of research Methodology used for this study is - Exploratory & Quantitative Research.

Hypothesis

The hypothesis proposed here is as mentioned below

HO - Optical fiber is more versatile and cost effective medium of transmission of information than traditional copper wire for Indian economy.

H1 - Optical fiber is not more versatile and cost effective medium of transmission of information than traditional copper wire for Indian economy.

Data Types and Sources:

There are two types of data types and sources:

- Primary data refers to data gathered by researchers directly from the main source. The sources of primary data are surveys, observations, questionnaires, journals, and articles to name a few. In this research questionnaires have been used.
- Secondary data refers to data that has already been collected through primary sources and is made readily available for other researchers to use it for their own research work.

Some advantages availed by the usage of primary data is that the data is considered to be reliable as it is usually objective as well as collected directly from the original source. It also provides up to date information about specific research topics compared to secondary data.

For this research, primary data has been used.

Sampling Methodology:

There are two types of sampling methods:

- Probability sampling involves random selection, allowing you to make statistical inferences about the whole group.
- Non-probability sampling involves non-random selection based on convenience or any other criteria, allowing you to easily collect initial data.

For this research, probability sampling has been utilized.

Population:

It is the maximum number of people from different fields to which the findings are to be generalized.

Sample Size:

A sample size of 55 respondents is selected to make this study relevant and meaningful.

Sampling Area:

The area of the research was the city of Mumbai, Finance Capital of India. Mumbai was selected as its open to new research and people are aware about new innovations and inventions.

Sampling Procedure:

The questionnaire was prepared for this study in the form of Google Form and was circulated via Whatsapp. This data collection did not require computer knowledge.

Limitations of this Study:

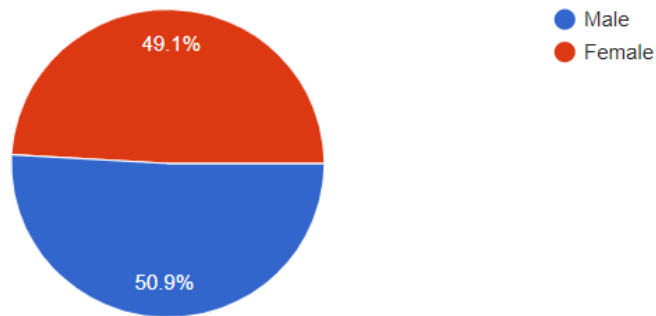
The entire study was just restricted to the city of Mumbai which restricted the study's target audience. As data collected was via Google form all answers cannot be said to be fully accurate. Major limitation was that respondents were lacking basic knowledge on the topic and had no background context. Due to cost constraints personal interaction was not possible which limited the scope of the study

4. DATA ANALYSIS AND PRESENTATION

We Took the Survey: The questionnaire Method and Results Were As Follows: We Got 55 Responses to the Compulsory Questions Asked Below:

What is your gender?

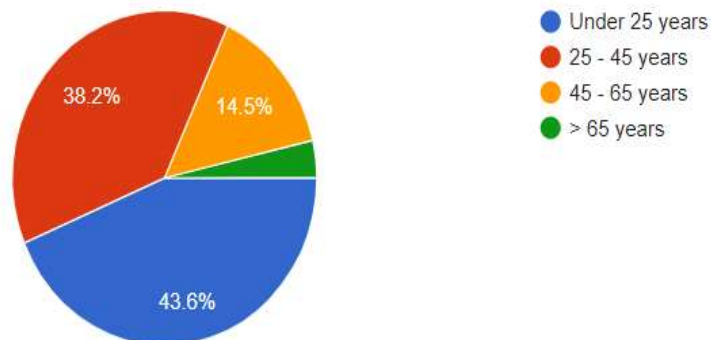
55 responses



This shows us that the amongst 55 responders there was an equal division between male and female responders thus avoiding any chance of a gender bias.

What is your age?

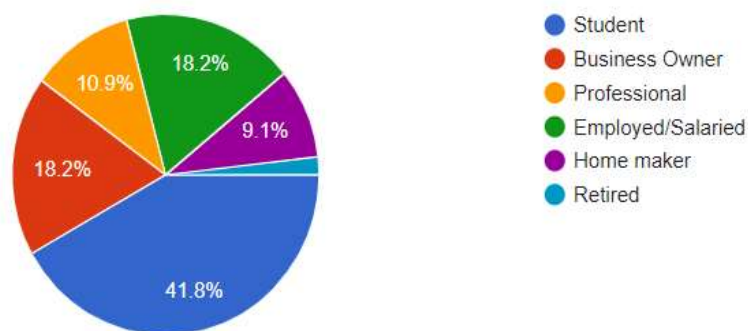
55 responses



We can see that the responders belonged to all possible age groups hence proving to be a fair study, while majority were under 25 years of age.

What is your profession

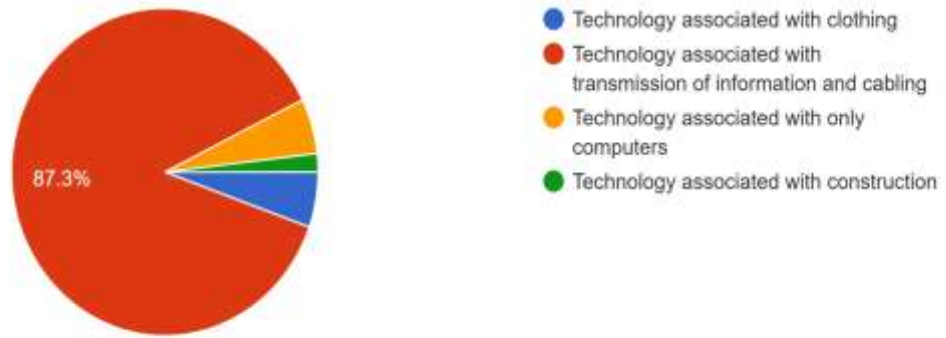
55 responses



We can infer that majority of the responses collected were from students apart from which people from all possible professions were part of the study.

What is Optical fibre?

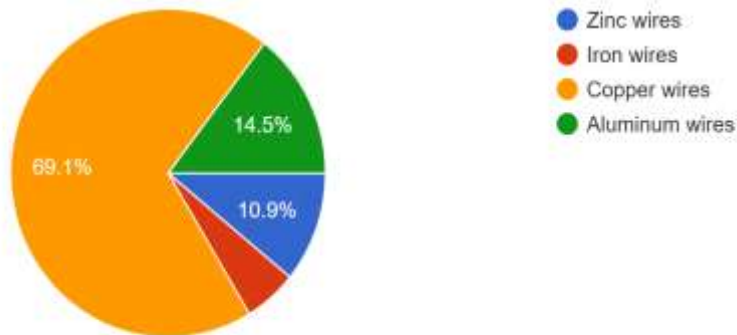
55 responses



A majority of 87.3% responders were aware of what optical fiber cables actually are.

Optical fibre has replaced which of the following?

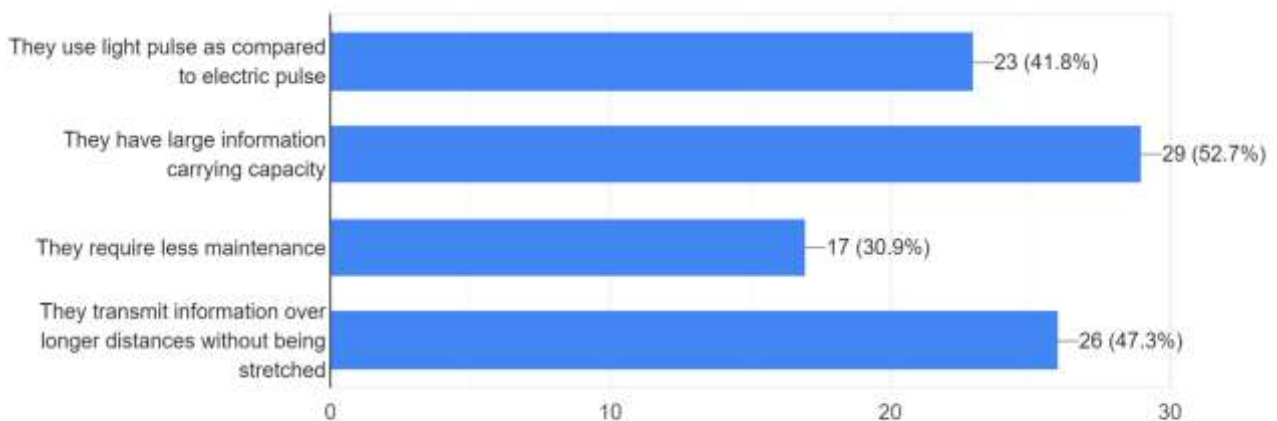
55 responses



Most people were aware about the fact that copper wires were replaced by optical fiber, while as compared to the majority few of the responders had wavering responses.

According to you why are optical fibres superior?

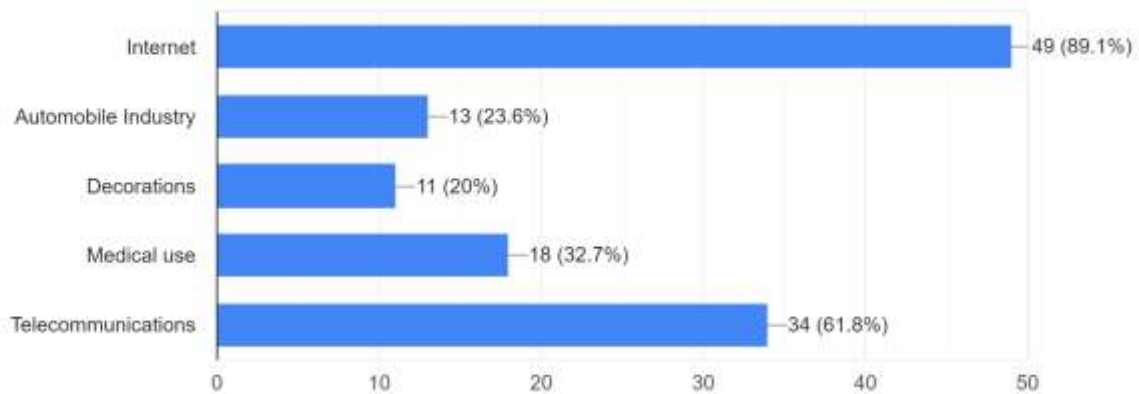
55 responses



This shows us that majority of the responders were aware of the reasons why optical fiber cables were superior over its substitutes.

According to you optical fibres can be used for?

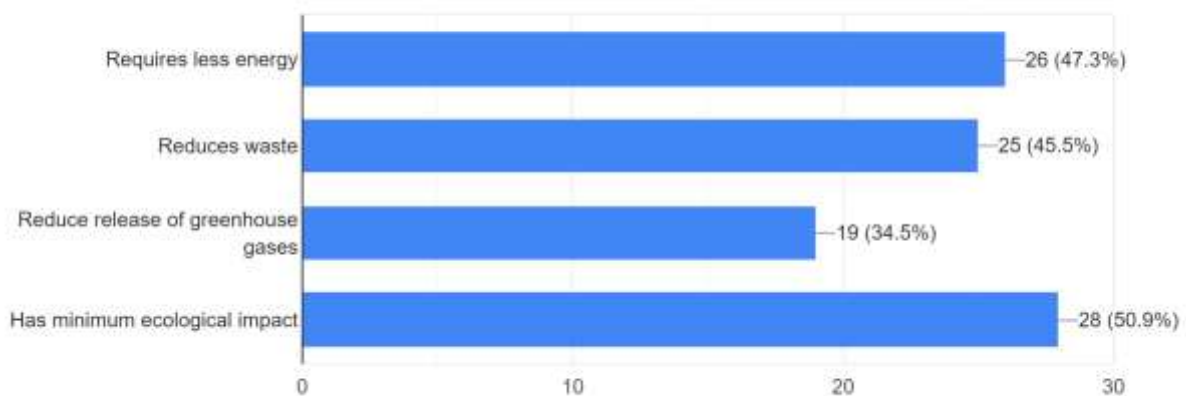
55 responses



It is clear from the above that responders were aware of the uses with 89.1% and 61.8% selecting Internet and Telecommunications respectively.

Why optical fibres are said to be environmental friendly?

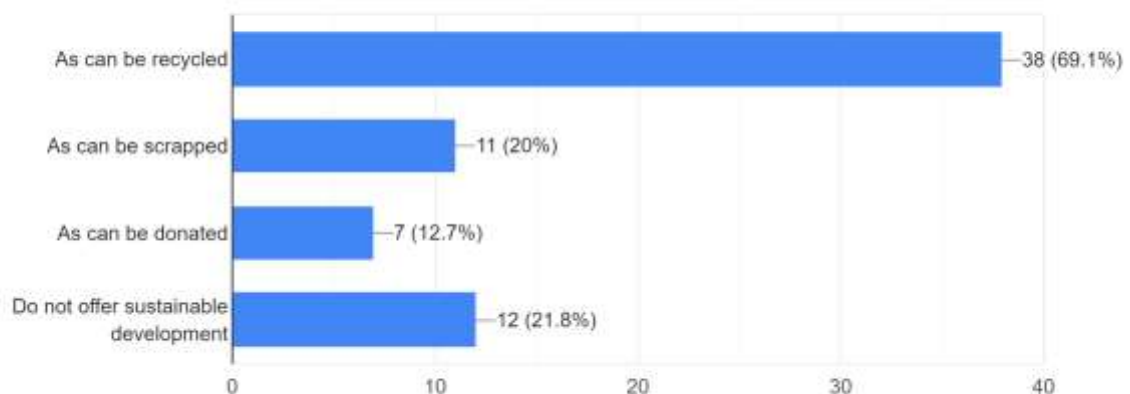
55 responses



This shows us that all responders were aware about the environmental factors relating to optical fiber cables, with all options getting almost the same amount of responses.

Optical fibre industry offers sustainable development?

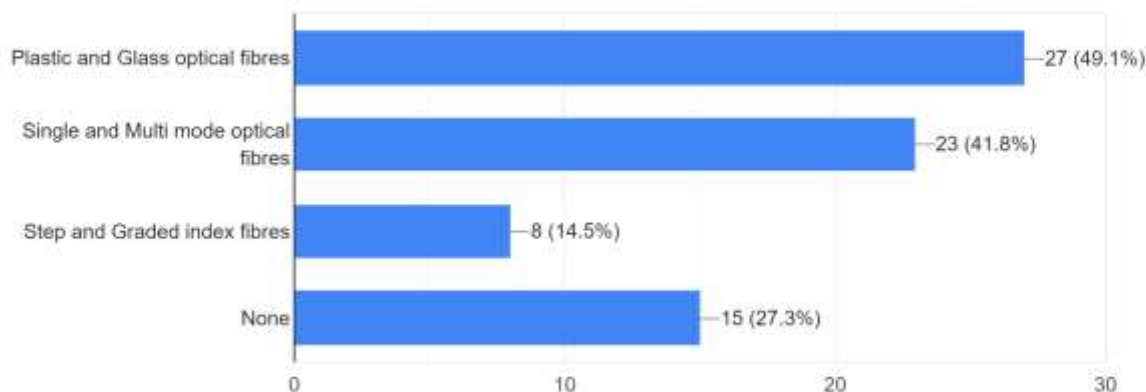
55 responses



We can deduce that most responders were aware about the reasons linking to sustainable development with few of the responders not having a clear purview on that front.

Which of the following types of optical fibre have you heard about?

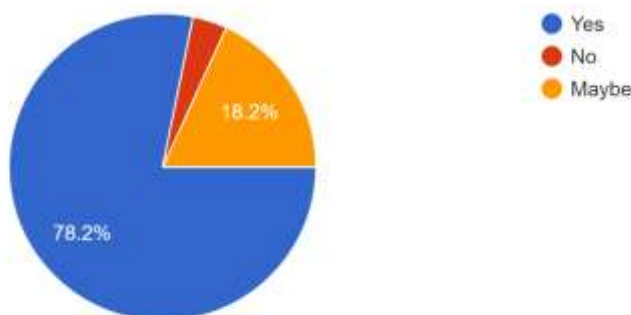
55 responses



This proves to us that almost more than 50% of the total responders were aware and have heard about optical fiber cables.

Do you think optical fibres can be used as versatile transmission medium for variety of applications?

55 responses



As high as 78.2% of respondents are aware about the fact that optical fiber cables offer a versatile medium of transmission.

5. FINDING, CONCLUSION, SUGGESTION

Finding

The diameter of optical fibres, which are long, thin strands made of glass or plastic, is comparable to that of a human hair. These optical fibres are used to transmit data between their two ends utilising light pulses. To create optical fibre cables, which are buried across the ocean's surface for global data transmission, optical fibres are bundled together. Silicon Dioxide, a primary raw material for optical fibres, can be found in sand, gravel, clay, granite, diatomaceous earth, and many other types of rock. Other compounds are also introduced in very small concentrations. On raw materials preform, drawing and cabling is performed to manufacture optical fibre cable. The production of preforms presents the greatest technical challenges and offers the best profit margins along the whole value chain. Preform production generates over 70% of all profits in the optical fibre value chain (Source). The technology to achieve it is only available to ten companies worldwide.

In 2019, the market for optical fibre cables was estimated to be worth USD 7.34 billion. In the upcoming years, the industry will benefit from double-digit growth from 5G and IoT.

2019 saw a decline in the installation of optical fibre cables for the first time since 2002. Due mostly to a decline in demand in China, 2019 saw 480 million fibre kilometres installed as opposed to 500 million in 2018. Due to their financial issues, Indian telecom players also reduced their capital spending in 2019. India is only 25% fiberized (compared to a global average of 60% and a US/China level of >60%). Demand has not yet materialised in India. This resulted in a build-up of performer inventory and a price adjustment in 2019.

Sterlite Technologies Limited, Himachal Futuristic Communications Ltd., Aksh OptiFiber Limited, Finolex Cables Limited, Birla Cables Limited, Vindhya Telelinks Limited, UM Cables Limited, Uniflex Cables Limited, West Coast Optilinks, Paramount Communications Limited, etc. are important Indian manufacturers of optical fibre cables. Since Sterlite Tech is the only firm in India with preform manufacturing technology at this time, its margins are higher than those of its competitors that produce optical fibre cable. The Indian optical fibre cable market was worth USD 880 million in 2019 (or about 12% of the total market size). Due to government efforts in improving internet coverage in India through initiatives like Digital India and Smart Cities, the business is

rapidly expanding. In the upcoming years, the Telecom and Defense sectors will also significantly contribute to the expansion of India's optical fibre network.

Conclusion

To deliver high-speed internet services, optical fibre cables are replacing outdated copper telecom connections. Over a distance of 100 metres, optical fibre loses only 3% of the transmission, compared to 94% for copper lines. In addition, optical fibres are stronger than copper wires, which are more prone to breakage. While optical fibres don't emit signals that can be picked up, copper wire can be easily tapped. Additionally, compared to copper cables, optical fibre has lower latency (the amount of time needed to transmit data). Optical fibres cable offers sustainable development as it can be recycled. It has minimum ecological impact, uses less energy, reduces waste making it environment friendly. This research study proves H1 hypothesis proving that Optical fiber is more versatile and cost effective medium of transmission of information than traditional copper wire for Indian economy.

Suggestion

India has potential to dominate the optical fibre industry with its edge on technology. China has recently started exporting surplus goods at exceptionally low prices, which appears to be dumping. India already possesses the necessary economies of scale and world-class manufacturing capabilities, with installed capacity that is greater than twice the annual demand within the nation. The ecosystem that produces optical fibres is harmed by such dumping. India must move quickly to stop this dumping before it is too late and our own superb optical fibre ecosystem has been destroyed. It is must for Indian government to take measures by controlling dumping and trade attacks to protect domestic technology and research and development.

6. REFERENCES

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Key Words

- Bandwidth: It is the maximum amount of data transmitted over an internet connection in a given amount of time.
- Transmission: Rate at which data is transferred,
- Propagate: It is referred to as the action or process of spreading of light.
- Cladding: a cover or coating on a structure or material.
- Patent: An exclusive right gained by the innovator for his/her innovation.
- Telecommunication: Transmission of information by various types of technologies over wire, radio, optical, or other electromagnetic systems.
- Pliable: Can be easily bent.
- Quantitative: Means measuring a particular thing by its quantity as opposed to its quality.

Appendix:

Questionnaire

1. What is your gender? *
 - Male
 - Female
2. What is your age? *
 - Under 25 years
 - 25-45 years
 - 45-65 years
 - >65 years
3. What is your profession *

- Student
 - Business Owner
 - Professional
 - Employed/Salaried
 - Home maker
 - Retired
4. What is Optical fibre *
- Technology associated with clothing
 - Technology associated with transmission of information and cabling
 - Technology associated with only computers
 - Technology associated with construction
5. Optical fibre has replaced which of the following *
- Zinc wires
 - Iron wires
 - Copper wires
 - Aluminum wires
6. According to you why are optical fibres superior? *
- They use light pulse as compared to electrical pulse
 - They have large information carrying capacity
 - They require less maintenance
 - They transmit information over longer distances without being stretched
7. According to you optical fibres can be used for? *
- Internet
 - Automobile industry
 - Decorations
 - Medical use
 - Telecommunications
8. Why optical fibres are said to be environmentally friendly? *
- Requires less energy
 - Reduces waste
 - Reduce release of greenhouse gases
 - Has minimum ecological impact
9. Optical fibre industry offers sustainable development? *
- As can be recycled
 - As can be scrapped
 - As can be donated
 - Do not offer sustainable development
10. Which of the following types of optical fibre have you heard about? *
- Plastic and Glass optical fibres
 - Single and Multi mode optical fibres
 - Step and Graded index fibres
 - None
11. Do you think optical fibres can be used as a versatile transmission medium for variety of applications? *
- Yes
 - No
 - Maybe