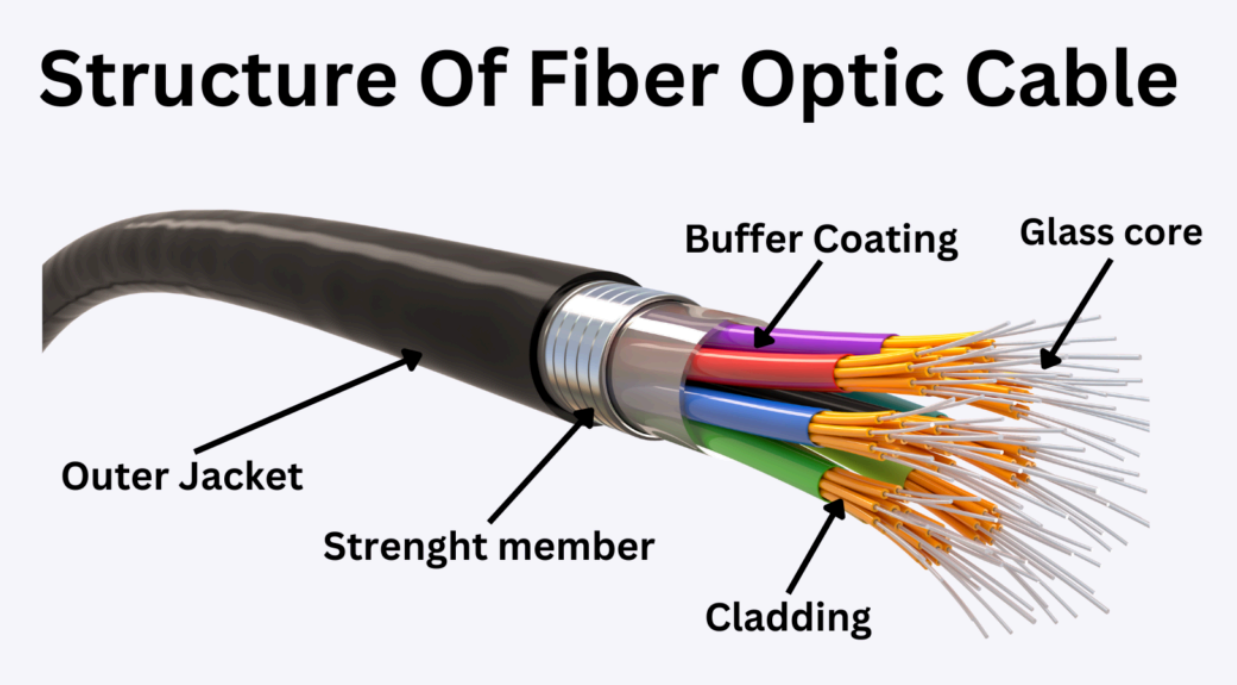
Info About Fibre Optics

Fiber optics is a device for transferring data traffic like a pulse of light over tiny optical fibers.

- ➢ Optical transceivers are a means of shifting data traffic in a fiber optic by turning data into light.
- ➢ This method allows high speed data to travel long distances without losing any data.
- ➢ Fiber optics is technology used by the world at homes, hotels, offices and other places.
- ➢ This technology is essential for modern data networks, telecommunications and the internet around us.
- ➢ A fiber optics cable is made up of thin shreds or strands that is no thicker than a human's hair.
- ➢ Fiber optics networks are now well confirmed into the world for now.
- ➢ There are different types of fiber optics solutions for use in many different cases.
- ➢ As a result fiber optics became a foundation for modern data transmissions and used in telecom, internet service provider and enterprise data center networks.

- ➢ These are the people who use fiber optics telecommunications, internet, medical industry, transportation,smart companies, campuses, cities , industrial automation and the big one the military
- ➢ Fiber optics is capable of transferring data at quicker speed over long distances

➢ The advantages are that transmission over long distances, lightning fast, less data loss, no corrosion and greater bandwidth



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➢ **What Are Fiber Optics**

➢ Fiber optics are technology that allows you to send information like, data, text, numbers, values and many more through the form of light.

➢ Fiber optics are made of very thin transparent wires that are covered in in a reflective metal called cladding then there is the buffer coating the the strength member to keep the wires together, and finally the outer jacket each of these many components play a very important role

The three types of optical cables are (SMF) single mode fibre, the second is (MMF) Multimode fibre, (POF) plastic mode fibre.

- (SMF) is a technology that uses the same as fibre optics but only uses one single strand of the glass core to send data from one technology to the next.
- (MMF) is a type of optical fibre which is used mostly for communications over short distances, such within a building or campus. Multimode fibre are described using a system of classification. ((MMF) is a special fibre as it holds separate wires within the strength member allowing it to transport many pieces of data.
- (POF) is similar to glass fiber optics but uses the material of polymer at the core; this does the same thing as a glass wire but it only uses plastic.
- Optic fibre is significantly faster than wi-fi as it uses the speed of light to transport data
- It cost around 100 dollars to make a fibre optic(MMF) wire
- A difference between copper and fiber optic is that fiber optic does not need to be replaced often ,but copper need to be replaced often

How does fiber optics work?

The speed of light inside of a vacuum is about 300 km per second (c)

This speed can be changed when it travels through water, gas, or glass (v)

C/V is known as the refractive index(n)

When a light beam comes out from the water, you can see a bit of light reflection and a lot more of the light slightly bends. This is called a refraction. When you tilt the beam of light slowly making the refraction get closer to the surface of the water when you get the right angle, you make the surface of the water act like a mirror, and you see the whole beam of light in the water. This is called total internal reflection.

This explains the fundamental principle of fiber optics when light entering the core reflects the cladding with a lower refractive index than the glass core making it travel through the core.

There are two main types of fiber optics, one is called a single mode fiber the other is a multimode fiber. The main difference is that the multi mode fiber core is much larger than the core for the single mode fiber. This makes it so the MMF can allow more data while SMF can allow few but less. One of the distances is that SMF can carry only one single mode of light

Connections to the real world

The Impurity Test:
Even in the manufacturer's very accurate construction of fiber optic cables there is still a chance, and it has happened before, where there are impurities in glass. A small tiny area with a different medium than glass could knock off the light signal. Causing somebody on the other side to retrieve a very different signal than what is said on the other side. A man named Charles Kao was awarded the Nobel Prize in 2009 for discovering that pure glass cores in fiber optics makes it easier for light to be transferred through these cables.

Curvature test:
When you install fiber optics into your home and the curve of the fiber optics when it takes a tight turn, it bends too sharply the critical angle is broken and causes the signal of light to go through the cladding, and the signal to disappear.

These are two problems with fibre optics in the real world that I can represent with this simple water experiment. But these are not the only, there are much more, and I will list them down below.

Problems with fiber optics

This very powerful tool that humans use today to connect with each other around the globe also has errors here are a few.

- **Breakage:**

Since the core of a fiber optic is made out of very pure glass even though it is thin there is a point where it can snap. I admit it is very flexible, BUT when it reaches a certain angle it can cause the fibre to snap. So it is like a hose, if it gets tangled in one area, it could cause the water not to flow because it is really twisted. Similar to this so it could eventually snap. And when it snaps then it becomes a problem. This snap could cause the signal of light to glitch making it difficult to send information through it.

- **Merging**

When installing a fiber optic cable into your house you will sometimes need to add another to it. So when connecting it you must make sure the glass core is perfectly aligned, and what makes it a so much more difficult job to perform with some cables being as small as a micrometer.

- **Expenses**

Because of the difficulties of fiber optics manufacturing this causes the prices of these products to rocket. So copper wires are often seen as the affordable solution.

Hypothesis

Main hypothesis:
 I think that when I demonstrate where the water flows out of the bottle it will get trapped in the flow of the water leaving the bottle giving it a shade of green.This is a phenomenon called total internal reflection. It makes it so that the light stays within the stream of water. In this experiment I will show three experiments that can relate to real life.

The Impurity Test:
 When we apply droplets of milk to the water the refractive index will increase. Which would mean that Total Internal Refraction is

much more easy to occur because of the change of its medium. So I think that the light of the laser will travel but will be harder to see (representing signal loss).

The Curvature Test:
I think that the refractive index would not be high enough for the phenomenon Total Internal Reflection to occur. Mainly, because if the curve of water is too sharp the light might be able to break through the surface of water, instead of it reflecting off the surface of the stream, I think it will not follow but continue forward with a slight bend.

Procedure:

For this investigation we will have a 2 liter jug with a hole in the middle that releases the water into a bucket from an angle. On the other side the red laser pointer will be pointed horizontally to aim at where the hole the stream exits from. And light will be reflected inside the stream trapping the light to follow. Fiber optics use the same principles to transport light.

Impurity test:
To do this we are going to put the substance water into the bottle and then we will cloud up the water with milk to see if the phenomenon of Total Internal Reflection would still occur, and whether the index changes or not depending on how strong the

total internal reflection is. But if it gets cloudy and the milk water and the laser light stays trapped then that would mean that there is signal loss.

Curvature test:
For this test we will test if the Total Internal Reflection will still work if it has a sharp stream of water or a high stream of water, depending on how full the water jug is. It would either have a sharp stream or a long stream.

Observations

Main Demonstration:

When I aimed the laser at the hole and then lended the laser to someone else I saw the laser light bend out of the bottle and follow the stream. When it followed all the way to the end of the stream it scattered at the bottom. When I saw it follow the stream, it proved the principle that fibre optics using Total Internal Reflection was possible. And the air around the stream acting as cladding even though it was clear it was able to trap the water inside.

Curvature Test:

As time passed the stream got shorter and shorter and I realised that the stream was not holding in as much light as it used to so some beams of light were able to escape. So I saw a little bit of light inside the stream meaning Total Internal Reflection was not as powerful anymore with the stream so close to the bottle

Impurity Test:

When I aimed the laser at the hole through the blurry milky water, and then passed it over to my partner I found out that the light from the laser was partially trapped inside of the laser stream making it so that on a surface that is parallel to the hole. I have a clear red dot.

Specifics:

If you looked closely at the laser lights path in the bottle of water the you would notice that it is very clear/visible compared to the Main Demonstration.

Analysis

Main Demonstration:

When the light came from the laser and went through the water it then escaped from the hole and into the stream. But when it reached the stream it was forced to follow it, because the water had a higher refractive index than air surrounding the stream. And the stream was flowing at an angle greater than the critical angle; this meant that the light had to go and follow the stream's path.

Curvature Test

When time passed, it caused the stream to get much narrower. So it made the stream flow at an angle less than the critical angle so that it made some of the laser lights pass through. Resulting in the laser light that followed the stream harder to see, as not all of the laser lights were not there.

Impurity Test:

What caused the water in the stream to only partially be capture the water inside of the stream, was because the bottle did not hold only one substance, but two. Water, And Milk. So this impurity made the path of the light much more translucent than water, this in turn caused the light particles to scatter breaking the straight ray of light. This meant that the particles were apart from each other so instead of clean reflection of the surface of the stream it go lost. This caused partial Total Internal Reflection to occur.

Conclusion

Main Demonstration:

The second the light came from the laser and went through the water, it was captured in the stream of water. When the light in the stream hit the water, it forced the light to follow the stream because the water has a higher refractive index from the water and the stream flowing at a greater angle. The critical angle of the stream meant the light from the laser had to go through the stream and follow.

Curvature Test:

As the time passes the stream gets narrower and narrower. And when the stream gets narrower it flows at an angle less than the critical angle, and because of this some of the light escapes. But since the stream has a higher refractive index than the surrounding substance then that would mean that some rays of light from the laser can stay in the
Stream.

Impurity test:

When I aimed the laser at the hole through the blurry milky water, and then passed it over to my partner I found out that the light from the laser was partially trapped inside of the laser stream making it so that on a surface that is parallel to the hole. I have a clear red dot. The reason this happened is because the light scatters in the bottle of water translucent material making it so that the particles get lost.
Specifics:
If you looked closely at the laser lights path in the bottle of water the you would notice that it is very clear/visible compared to the Main Demonstration. This happened because particles travel much slower in milky water than water.

In conclusion, the experiment results matched the results we expected through our research, even though it was not as specific.