PENETRATION PHENOMENON OF LIGHT THROUGH DAILY USE PRODUCTS- MILK AND OIL

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Abstract-

Though optical fibres have many advantages, they have noticeable disadvantages as well. So there is a need to look for other alternatives. This paper explores the penetration phenomenon of the light through some daily use products like milk and oil. Some of the light will be absorbed when passed through these mediums and remaining will be collected and measured by optical detector (optical power meter). This measured light may be used to detect the adulteration in these products.

Keywords- Optical fiber, dBm, optical source and power meter

I. Introduction

Fiber optics is a major building block in the telecommunication infrastructure. Its high bandwidth capabilities and low attenuation characteristics make it ideal for gigabit transmission and beyond. Since its invention in the early 1970s, the use of and demand for optical fiber have grown tremendously. The uses of optical fiber today are quite numerous. With the explosion of information traffic due to the Internet, electronic commerce, computer networks, multimedia, voice, data, and video, the need for a transmission medium with the bandwidth capabilities for handling such vast amounts of information is paramount.[1] Fiber optics, with its comparatively infinite bandwidth, has proven to be the solution. Optical telecommunication is any form of telecommunication that uses light as the transmission medium. It can be performed visually or through electronics. An optical telecommunication system uses a transmitter, which encodes a message into an optical signal, a channel, which carries the signal to its destination, and a receiver, which reproduces the message from the received optical signal. Advantages of fiber optics are :[2]

(1) Large bandwidth, light weight, and small diameter,
(2) Designed for future applications needs,
(3) Long-distance signal transmission,
(4) Non conductivity,

(5) Security.

However, infrastructure development of fiber-optic systems is complex, time consuming and expensive to install and operate. Due to these difficulties, fiber-optic communication systems are primarily being installed in long-distance applications, where they can be used to their full transmission capacity, offsetting the increased cost. Optical fibers are more difficult and expensive to splice than electrical conductors. And at higher powers, optical fibers are susceptible to fiber fuse, resulting in catastrophic destruction of the fiber core and damage to transmission components. In short distance and relatively low bandwidth applications, some other medium should be preferred which has lower material cost, where large quantities are not required, lower cost of transmitters and receivers, capability to carry electrical power as well as signals (in appropriately designed cables) and ease of operating transducers in linear mode. So optical communication through some other medium should be developed for short box-to-box, backplane, or chip-to-chip applications.[3]

II. Optical Power meter

An optical power meter (OPM) is a device used to measure the power in an optical signal. The term usually refers to a device for testing average power in fiber optic systems. A typical optical power meter consists of a calibrated sensor, measuring amplifier and display. The sensor primarily consists of a photodiode selected for the appropriate range of wavelengths and power levels. On the display unit, the measured optical power and set wavelength is displayed. Power meters are calibrated using a traceable calibration standard such as a NIST standard. A traditional optical power meter responds to a broad spectrum of light, however the calibration is wavelength dependent.[4]

Fig1- Optical power meter[5]

III. Optical Source

Semiconductor optical sources have the physical characteristics and performance properties necessary for successful implementations of fiber optic systems. It is desirable that optical sources:

(1) Be compatible in size to low-loss optical fibers by having a small light-emitting area capable of launching light into fiber,

(2) Launch sufficient optical power into the optical fiber to overcome fiber attenuation and connection losses allowing for signal detection at the receiver,

(3) Emit light at wavelengths that minimize optical fiber loss and dispersion,

(4)Optical sources should have a narrow spectral width to minimize dispersion and Allow for direct modulation of optical output power Maintain stable operation in changing environmental conditions (such as temperature) Cost less and be more reliable than electrical devices, permitting fiber optic communication systems to compete with conventional systems Semiconductor optical sources suitable for fiber optic systems range from inexpensive light-emitting diodes (LEDs) to more expensive semiconductor lasers. [6]

Fig2- Optical source[5]

IV. dBm

dBm (sometimes dBmW) is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW). It is used in radio, microwave and fiber optic networks as a convenient measure of absolute power because of its capability to express both very large and very small values in a short form.
0 dBm equals 1 milliwatt. A 3 dB increase represents roughly doubling the power, which means that 3 dBm equals roughly 2 mW. For a 3 dB decrease, the power is reduced by about one half, making −3 dBm equal to about 0.5 milliwatt.
To express an arbitrary power P in watts as x in dBm, or vice versa, the following equations may be used:[7]

$$x = 10\log_{10}(1000P)$$
$$x = 10\log_{10}P + 30$$

$$P = \frac{1}{1000}10^{\frac{x}{10}}$$
$$P = 10^{\frac{1}{10}(x-30)}$$

V. Measuring Power Losses

A. OPTICAL FIBER

Measured through the optical power meter, the loss came out to be -45.97dBm.
Using the formula stated above :
P comes to be 25.29nW
POWER LOSS=25.29nW

B. PURE MILK

Measured through the optical power meter, the loss came out to be -57.91dBm.
Using the formula stated above :
P comes to be 1.618nW.
POWER LOSS=1.618nW

C. OIL

Measured through the optical power meter, the loss came out to be -38.97dBm.
Using the formula stated above :
P comes to be 126.7nW.
POWER LOSS=126.7nW

D. TAP WATER

Measured through the optical power meter, the loss came out to be -20.31dBm.
Using the formula stated above :
P comes to be 9310nW.
POWER LOSS=9310nW

E. MILK WITH WATER

Measured through the optical power meter, the loss came out to be -50.19dBm.
Using the formula stated above :
P comes to be 9.57nW.
POWER LOSS=9.57nW

F. MILK WITH VARYING CONC. OF WATER

Table1. %water in milk and power loss

% water in milk	Power Loss(dBm)	Power Loss(nW)
10	-55.91	2.56
20	-51.78	6.64
30	-49.97	10.07
40	-45.34	29.24
50	-42.10	61.66
60	-39.97	100.69
70	-36.28	235.50
80	-31.13	770.90
90	-27.14	1931.97
100	-22.19	6039.49

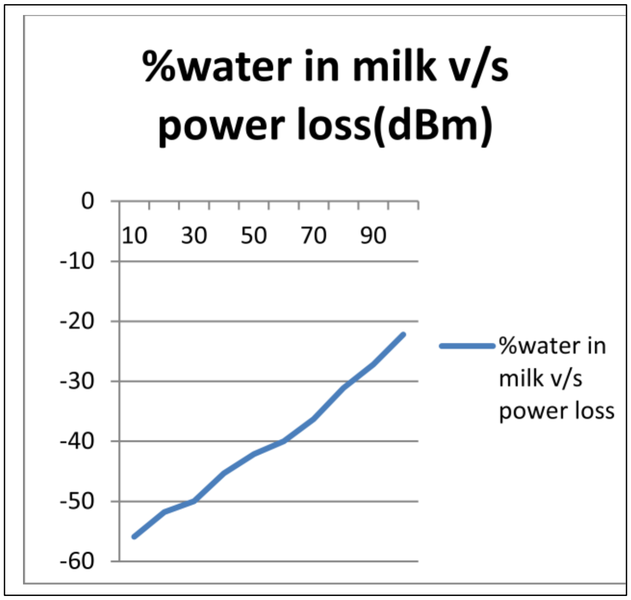

Fig-3: %water in milk v/s power loss

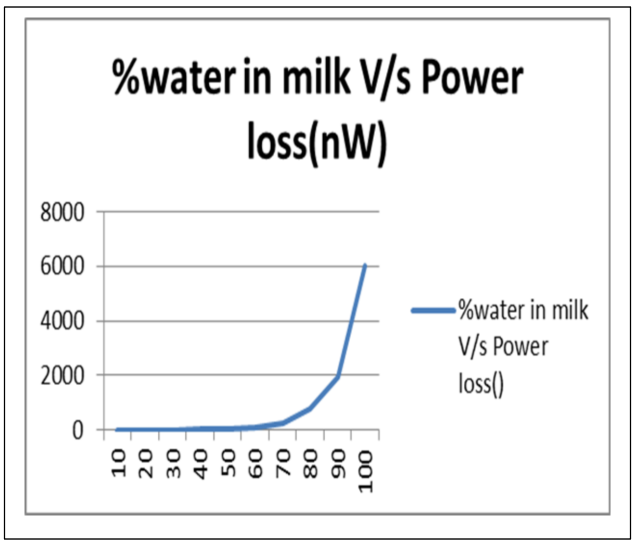

Fig-4: %water in milk v/s power loss

VI. Conclusion

Various other alternatives to the optical fibres are presented such as pure milk and oil. It was found that pure milk proved to be a very good alternative as it showed a power loss of only 1.618nW compared to the 25.29nW power loss in the optical fiber. Oil had a power loss of 126.7nW. When water was added to the milk, variation in the power losses was observed with varying percentage of water.

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VIII. References

[1]http://www.fiberoptics4sale.com/wordpress/fiber-optics-for-telecommunicationa-complete-and-quick-tutorial-part-1/

[2] Melling, Peter J.; Thomson, Mary (2002). "Fiber-optic probes for mid-infrared spectrometry". In Chalmers, John M.; Griffiths, Peter R. (eds.) (PDF). (Handbook of Vibrational Spectroscopy. Wiley)

[3] Carr, Joseph (2002). RF Components and Circuits. Newnes. pp. 45-46. ISBN 978-0750648448

[4] Professor Cyrus D. Cantrell of The University of Texas at Dallas pdf on optical detectors

[5]http://www.atecorp.com/products/tektronix/top200.aspx

[6] http://www.toolingu.com/definition-460355-34953-optical-source.html

[7] Chinn, H.A.; D.K. Gannett, R.M.Moris (January 1940). "A New Standard Volume Indicator and Reference Level". Proceedings of the Institute of Radio Engineers 28 (1): 1-17. doi:10.1109/JRPROC.1940.228815.