Analysis of Experimental values of Bend Loss by OTDR

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Abstract- In this paper, showed the measurement of bend loss in single mode fiber and multimode fiber in different bend radius at different wavelength by using OTDR and compares the value of bend loss of single mode fiber with standard paper and also performed reduce the bend loss at particular radius .

Keywords – Single mode cable, multi mode cable, power meter, OTDR.

I. INTRODUCTION

The optical fiber bending loss is created by that light fail to comply with this requirement of total internal reflection.

In other word, bending an optical fiber introduce a loss in light power or attenuation. This is one of the major causes of the total attenuation that light experiences while propagating through an optical fiber. The result is failure to achieve total internal reflection in the bent fiber .Which means that some portion of the beam is escaping from the core of the fiber .Hence the power of the light arriving at its destination will be less than the power of light emitted into the fiber from a light source.

Although optical fiber bending loss goes against signal transmission. In this paper, study the trend of change of bending loss Characteristics in different mode field diameter fiber and under diverse condition, such as tension /pressure and different temperature [1].

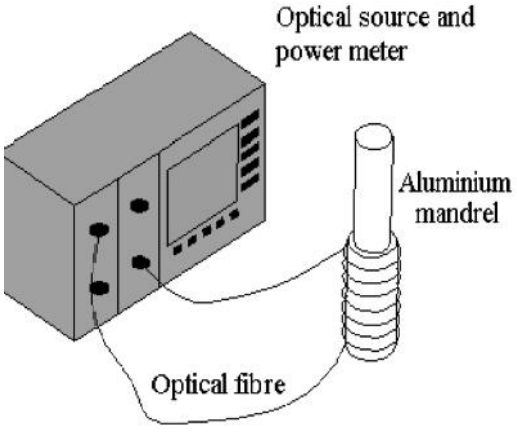

Fig.1. Schematic diagram of the optical set-up for measuring bending loss of the fiber.

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In real, Measurement of the bending loss reflects power distribution in optical fiber. We may measure using by Optical Power Meter and OTDR in such experiments. I choose OTDR in my research and Figure 2 shows the course of measuring. There is OTDR at the left. In addition, OTDR works, based on Fresnel reflection and Rayleigh scattering.

II. THEORY

We first considered the bending loss of different radius at different angle of single and multimode fiber. In single mode has a narrow core so one mode can pass and multimode fiberhas large core compare to single mode. So different light ray can be pass and compare the bend loss of single mode fiber with multimode fiber at different angle. I analyzed the relationship between them. Bend loss is related to bend radius and conduction laser wavelength. Measure optical fiber was G.652. So parameters are (i) Core radius, a = 14.2 µm, n1 = 1.50047, n2=1.5.

(ii) The core radius, a = 14.3µm, n1 = 1.50047 n2 = 1.5, R = 100 mm.

For single mode fiber we change the wavelength and radius the bend of the cable. This table-1 show bends loss of single mode fiber at wavelength 1310nm.

Table No. 1

Bend radius r mm	Circum-Ference Ccm	The no. of laps n	Total loss in db	The loss of each lap So	The loss of per unit length So/c
5	**3.1416**	**1**	**2.236**	**1.118**	**.356**
6	**3.7699**	**1**	**0.998**	**0.333**	**.088**
7	**4.3982**	**1**	**0.935**	**0.234**	**.053**
8	**5.0265**	**1**	**0.378**	**0.063**	**.013**
9	**5.6549**	**4**	**0.316**	**0.045**	**.008**
10	**6.2832**	**8**	**0.018**	**0.003**	**.048**

12	**7.5398**	**14**	**-0.07**	**-0.008**	**-.001**
13	**8.1681**	**25**	**-0.011**	**-0.001**	**-0.012**

Being based on these parameters, we can draw two charts that showed the dependence of bend loss on both radius and wavelength. Comparing measurements with the theoretical value. We can come to a conclusion that the errors were not large, as in Figure1 showed.

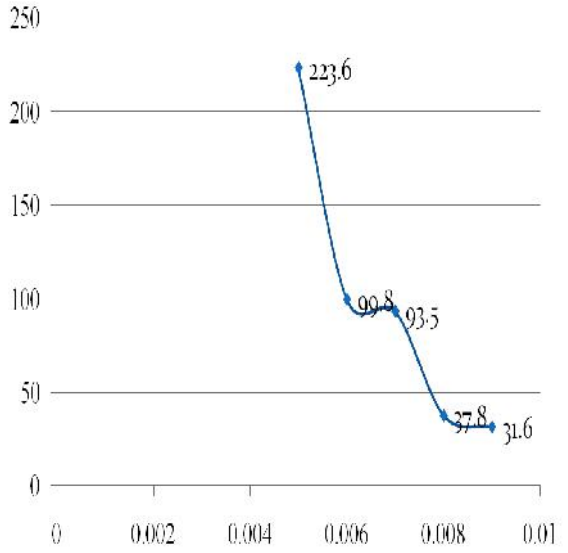

Fig. 1-comparing the value of the academic and practical on the bend loss.

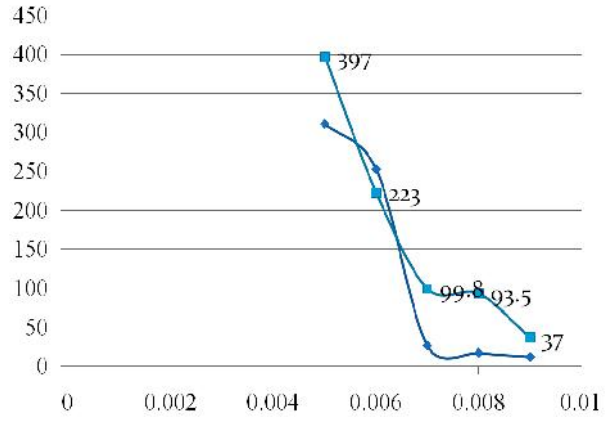

Fig.2- the bend loss of two wavelength

Show the bend loss of power meter shined the lasers with the wavelength of 1550nm and 1310nm. There were bending loss measurement dates of them, as Figure 5 showed. As can be seen from the graph, losses at a wavelength of 1550nm were greater than at 1310nm under the same bending radius. two wavelength.

Now comparing the bend loss of single mode fiber in different radius with the standard table.

Table No-2

Bend radius r mm	**Circum-ference**	**The no. of laps n**	**Total loss in db**	**The loss of each lap So**	**The loss of per unit length So/c**
5	**3.1416**	**1**	**7.453**	**7.453**	**2.376**
6	**3.7699**	**1**	**5.344**	**5.344**	**1.14183**
7	**4.3982**	**1**	**2.653**	**2.653**	**0.6035**
8	**5.0265**	**1**	**0.995**	**0.995**	**0.198**
9	**5.6549**	**4**	**2.235**	**0.5587**	**0.0988**
10	**6.2832**	**8**	**3.141**	**0.3926**	**0.0625**
11	**6.9115**	**10**	**0.876**	**0.0876**	**0.0127**
12	**7.5398**	**14**	**1.063**	**0.0759**	**0.0101**
13	**8.1681**	**25**	**0.938**	**0.0375**	**0.0046**
14	**8.7965**	**40**	**1.196**	**0.0299**	**0.0034**

Here can be seen in this table error is large compare to table no-1. We can come to conclusion error is not large with increase no. of radius .So, this table use for verify the previous table of measurement of bend loss in different radius.

Table No-3

This table show of bend loss of multimode fiber in different radius by using wavelength 1310 nm.

Bend radius r mm	**Circum-ferece**	**The no. of laps n**	**Total loss Sdb**	**The loss of each lap So**	**The loss of per unit length So/c**
5	**3.1416**	**1**	**.500**	**.500**	**0.159**
6	**3.7699**	**1**	**.480**	**.480**	**0.128**
7	**4.3982**	**1**	**.200**	**.200**	**0.046**
8	**5.0265**	**1**	**.150**	**.150**	**.030**
9	**5.6549**	**4**	**.130**	**.520**	**0.092**
10	**6.2832**	**8**	**.100**	**.800**	**0.127**
11	**6.9115**	**10**	**.090**	**0.900**	**.130**
12	**7.5398**	**14**	**.007**	**0.098**	**0.013**
13	**8.1681**	**25**	**.003**	**0.075**	**.009**
14	**8.7965**	**40**	**.001**	**0.040**	**0.005**
15	**9.4248**	**50**	**-0.010**	**0.500**	**-0.053**

This table show of bend loss of multimode fiber in different radius by using wavelength 1550 nm.

Bend radius r mm	Circu m-Ferenc e c cm	The no. of laps n	Total loss Sdb	The loss of each lap So	The loss of per unit length
5	3.1416	1	0.130	0.130	0.041
6	3.7699	1	0.110	0.110	0.029
7	4.3982	1	0.080	0.080	0.018
8	5.0265	1	0.040	0.040	0.008
9	5.6549	4	0.020	0.080	0.014
10	6.2832	8	0.010	0.080	0.013
11	6.9115	10	-0.02	-0.20	-0.029
12	7.5398	14	-0.11	-1.54	-0.205
13	8.1681	25	-0.15	-3.75	-0.199

Table No-4

We can see at both table no.3 and 4 that errors are large at the wavelength 1550 nm. That means if increase wavelength than bend loss will be increase with bend radius. Show that losses at a wavelength of 1550 nm greater than at 1310 nm under the same bending radius. Loss can be reduced at a particular radius when output power goes to same input power or approximately.

Being based on these parameters, we can draw two charts that showed the dependence of bend loss on both radius and wavelength. Comparing measurements with the theoretical value. We can come to a conclusion that the errors were not large.

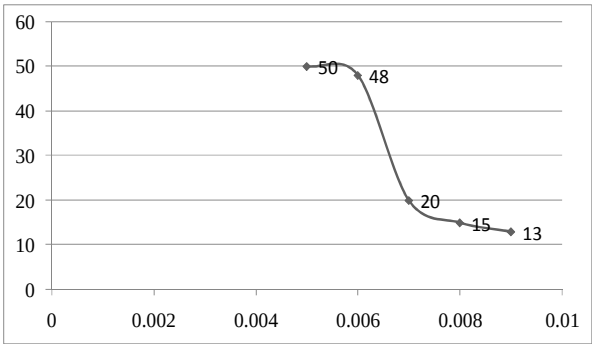

Fig. 3 -comparing the value of the academic and practical on the bend loss.

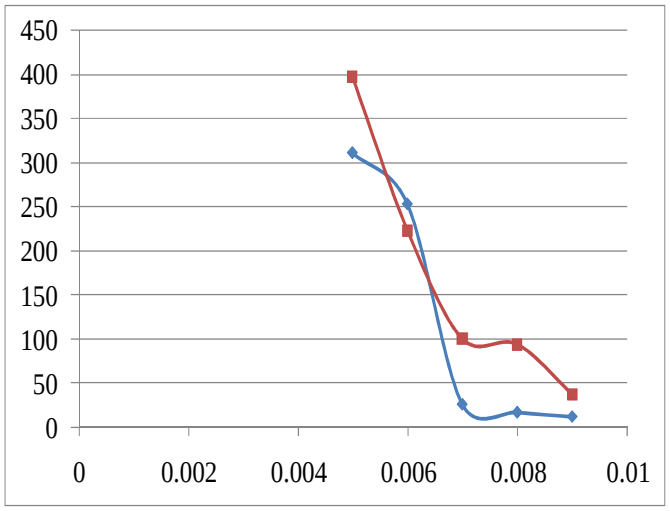

Fig. 4 - the bend loss of two wavelength

I have got a normal curve measuring by OTDR.as shown as Figure 5.

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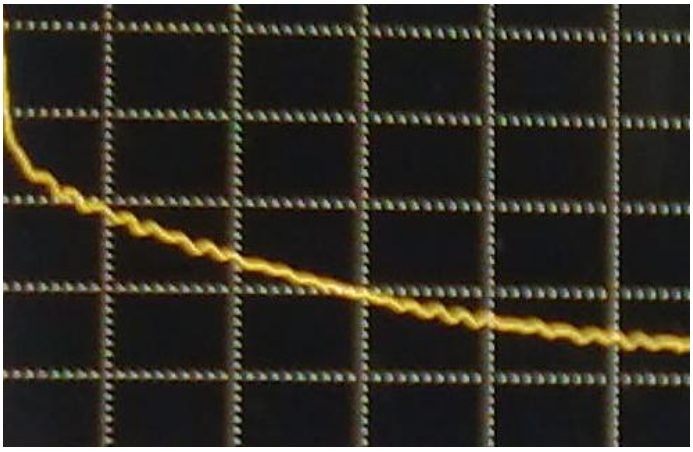

Fig.5- wave form of straight fibe

In figure (5) show curve by OTDR when cable has no bend, here can be seen cable goes to straight. In figure (6) cable bend at below 5mm than o/p get to distorted that means if cable bend at below 5mm than o/p power get more losses.

In figure (7) when cable bend at 11 mm radius than o/p power get less loss .It can be measure by Power meter.

It proved that loss can be reduced at particular radius with the help of power meter and OTDR .if cable bend at below 5 mm than output power get more loss. So it has limitation cable can not be bend at below 5 mm.

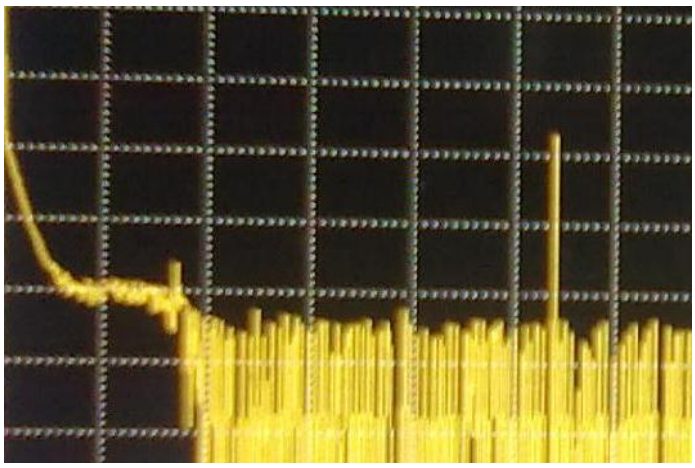

Fig.6-The loss line in bend radius at 8 mm.

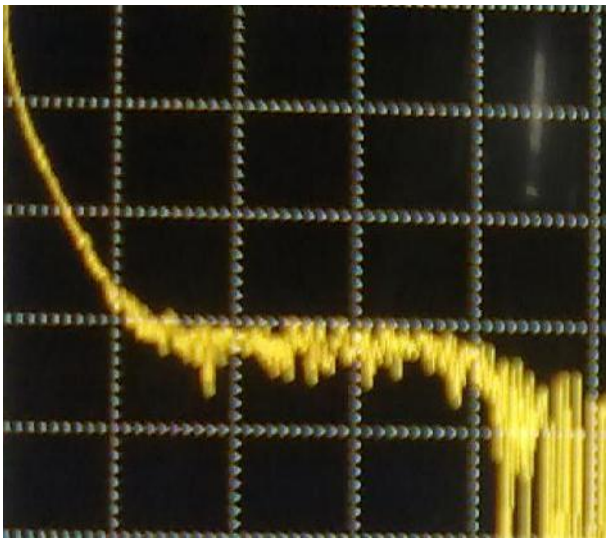

Fig 7- The loss line in bend radius at 11 mm

III. CONCLUSION

In this paper a study of bending loss of the fiber cable at diffrerent radius at different wavelength of single and multimode fiber.and reduce the bend loss of both fiber cable at 11mm for single mode and 12 mm for multimode fiber.Show the result calculate the bend loss about single mode and multimode and test proved that the bend loss varied inversely as the bending radius with the wavelength being constant,At the same time ,Some radius of bend cable by power meter ,when having a bend in different positions .

So comparing the measured curve that was got in real time with curves.

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