International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-7 Issue-3, July 2018

Power Analysis of Optical Fiber Laser

Ekta Bansal, Nidhi

***Abstract:** The laser fields are very wide and advance for the coming optical generations. Fiber lasers are worth to play a vital role in the upcoming new uprising of science due to their role in experimental operations and to their strong experimental arrangement for any starter. Different categories of optical laser found for widespread use such as Erbium Doped Fibre laser (EDFL), Ytterbium Doped Fibre Laser (YDFL). We consider about EDFL and YDFL which are made by doping the fibre core with rare-earth elements of Erbium and Ytterbium respectively. The system has been designed to analyze the gain and pump power and output power dependence of the optical laser EDFL and YDFL for various fiber lengths. The output power of YDFL in ring resonator is 40mW and in linear resonator is 25mW, which is better than EDFL which gives 20mW in ring and 10mW in linear. The YDFL gives better output power then EDFL. Ring resonator is better than linear resonator.*

***Index Terms:** Fiber Length, Gain, Output Power, EDFL and YDFL*

I. INTRODUCTION

Laser and its products are playing vital roles in a wide area of science and technology, because of their benefits and great competences in the field of army, medical and communications. The laser fields are very wide and advance for the coming optical generations. Fiber lasers are worth to play a vital role in the upcoming new uprising of science due to their role in experimental operations and to their strong experimental arrangement for any starter. It is a simple task to deal with limited laser in fibers and substitute the different parts for fiber laser configuration in process to illustrate and analyze its outputs. It is important to make the engineers and researchers to design, analyze and study the theory and experiment of lasers. To analyze the experimental output based on theory is the only way to understand the difficulty of lasers. To simulate these results is an easy method for any engineers and researchers to understand the properties of laser.

In this paper we have simulated Erbium Doped Fibre Laser (EDFL)], Ytterbium Doped Fibre Laser (YDFL) for ring and linear resonator.

Revised Manuscript Received on 30 July 2018.
* Correspondence Author
Ekta Bansal, M.Tech Scholar, Department of Electronics and Communication Engineering, Prannath Parnami Institute of Management & Technology, Hisar (Haryana)-125001, India. E-mail: ektabansal012@gmail.com
Nidhi, Assistant Professor, Department of Electronics and Communication Engineering, Prannath Parnami Institute of Management & Technology, Hisar (Haryana)-125001, India. E-mail: nidhibajaj44@gmail.com

II. EXPERIMENTAL WORK

A. EDFL:

System Parameter for Experiment

Parameter for EDFL given in table 1, pump wavelength is 1480nm with signal wavelength of 1550nm. Pump power 1000mw and single power 0.03mw is applied. Doped fiber length of 10m and doped fiber core diameter 5.5um.

Table 1: Parameter for EDFL

Pump wavelength(nm)	980
Signal wavelength(nm)	1550
Pump power(mw)	100
Signal power(mw)	0.03
Doped fiber length(m)	10
Doped fiber core diameter(um)	5.5

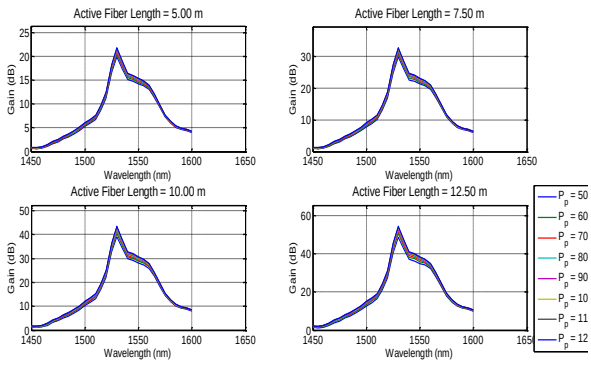

Figure 1: Wavelength vs Gain

Figure 1 gives the gain of EDFL 20dB, 30dB, 40dB and 45dB with fiber length at 5m, 7.5m, 10m and 12.5 m respectively at 1550nm wavelength and gain is nearly same for different pump powers varying from 10mW to 90mW.

B. Resonator Type: Ring

An **optical ring resonator** in which at least one closed loop coupled of light input and output is there. When light of the required wavelength is distributed through the ring from input, it makes in intensity over multiple round-trips due to constructive interference. Because only a selected wavelength will be at resonance within the ring.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

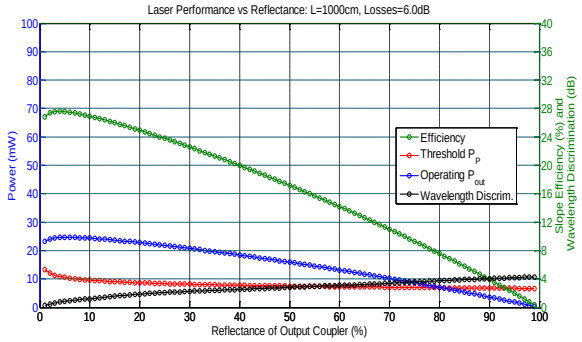

Figure 2: Reflectance of Output Coupler vs Power

Figure 2 gives the reflectance of output coupler and pump power. As the reflectance increases the required pump power decreases.

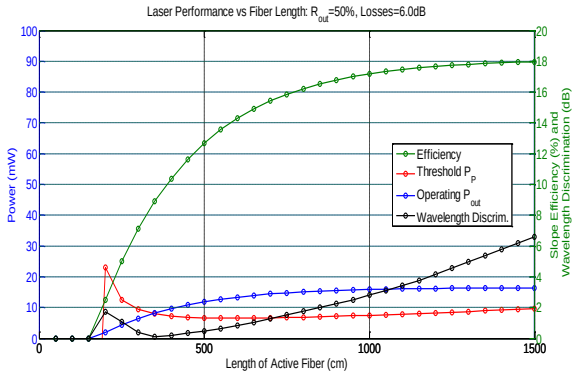

Figure 3: Length of Active Fibber vs Power

With forward pumping the efficiency of the laser increase with increase in length of fiber as shown in figure 3.

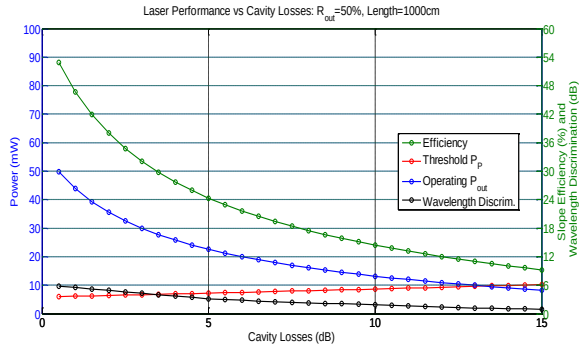

Figure 4: Cavity Losses vs Power

As the cavity losses increases the power and efficiency decreases.

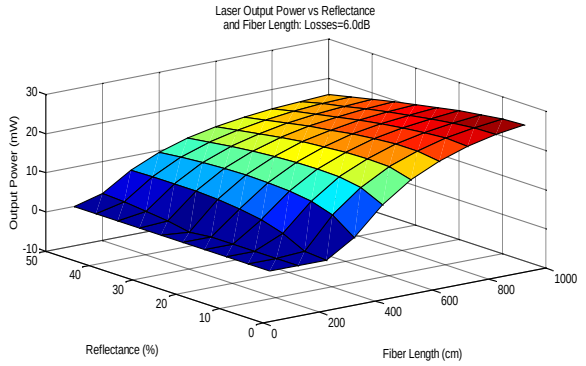

Figure 5: Laser output vs Reflectance and Fiber Length

Laser output power, reflectance and fiber length is shown in figure 5.

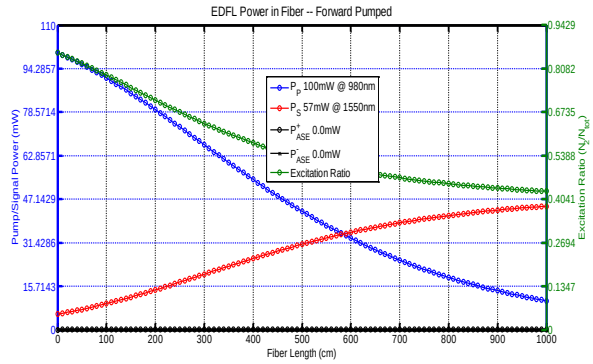

Figure 6: Fibber Length vs Pump/Signal Power

Pump power decrease and signal power increases as the length of fiber increases.

C. Resonator Type: Linear

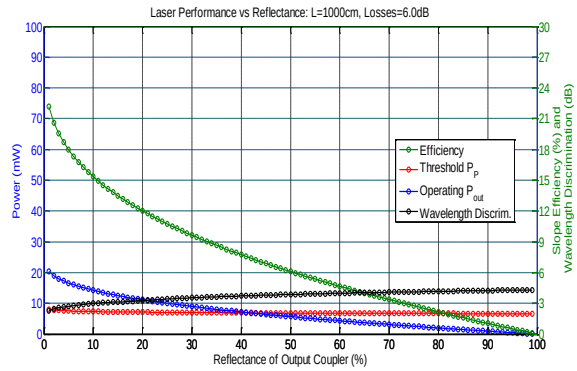

Figure 7: Reflectance of Output Coupler vs Power

Figure 7 gives the reflectance of output coupler and pump power. As the reflectance increases the required pump power decreases. In linear type resonator efficiency decreases very sharply as compared to ring type resonator.

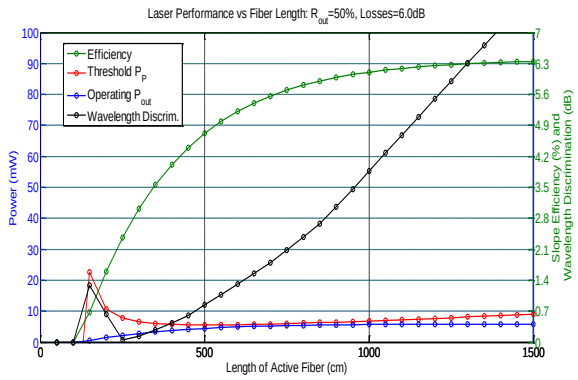

Figure 8: Length of Active Fibber vs Power

With forward pumping the efficiency of the laser increase with increase in length of fiber as shown in figure 8. It is nearly the same as ring resonator.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

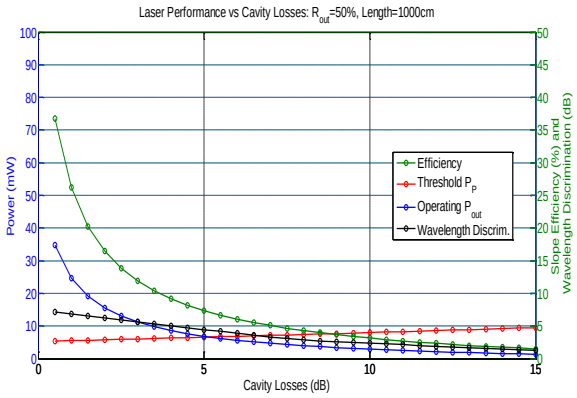

Figure 9: Cavity Losses vs Power

As the cavity losses increases the power and efficiency decreases. Losses are also high in linear resonator. Laser output power, reflectance and fibber length is shown in figure 10. Output power is only 10mW in linear as compared to 30mW in ring type resonator.

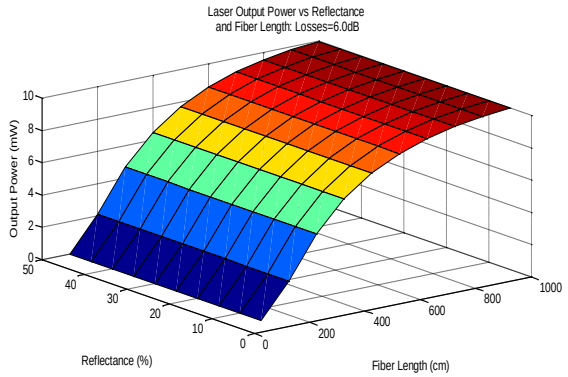

Figure 10: Laser Output vs Reflectance and Fibber Length

D. YDFA:

System parameter for experiment

Table 2: YDFA Parameter

Pump wavelength(nm)	975
Signal wavelength(nm)	1064
Pump power(mw)	225
Signal power(mw)	0
Doped fiber length(m)	1
Doped fiber core diameter(um)	6

Parameter for YDFA given in table 2, pump wavelength is 975nm with signal wavelength of 1064nm. Pump power 1000mw and single power 5mw is applied. Doped fiber length of 1m and doped fiber core diameter 6um.

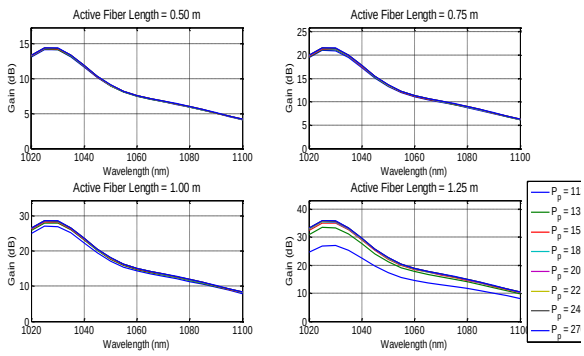

Figure 11: Wavelength vs Gain

Figure 11 gives the gain of YDFL 14dB, 21dB, 29dB and 35dB with fiber length at 5m, 7.5m, 10m and 12.5 m respectively at 1064nm wavelength and gain is nearly same for different pump powers varying from 10mW to 30mW.

E. Resonator Type: Ring

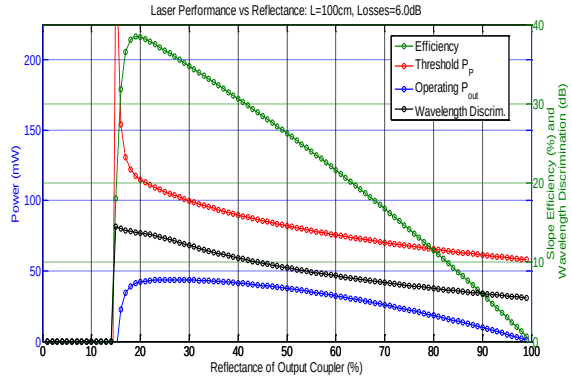

Figure 12: Reflectance of Output Coupler vs Power

Figure 12 gives the reflectance of output coupler and pump power. As the reflectance increases the required pump power decreases. But its efficiency is nearly 3times more then EDFL.

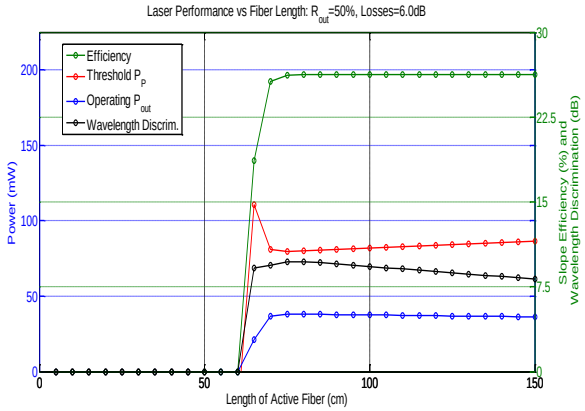

Figure 13: Laser performance vs Fibber Length

With forward pumping the efficiency of the laser remains constant for entire fiber length as shown in figure13.

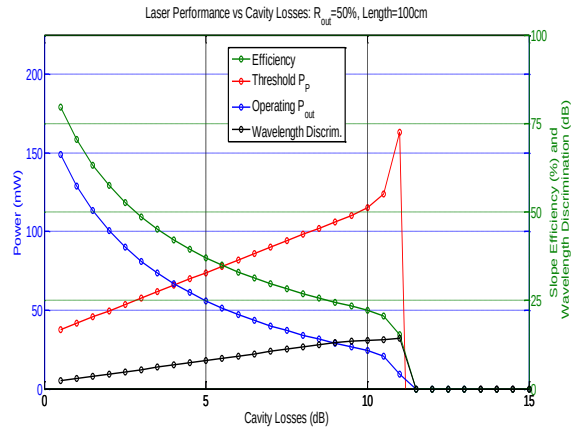

Figure 14: Laser Performance vs Cavity Losses

As the cavity losses increases the power and efficiency decreases.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

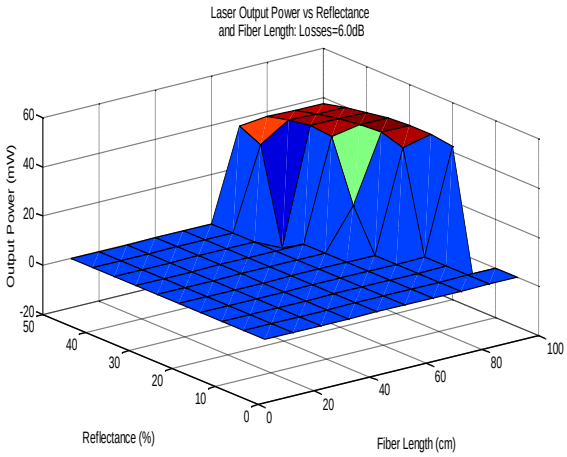

Figure 15: Laser Output Power vs Reflectance and fibber Length

Laser output power, reflectance and fiber length is shown in figure 15. The output power of YDFL is 40mW which is better than EDFL.

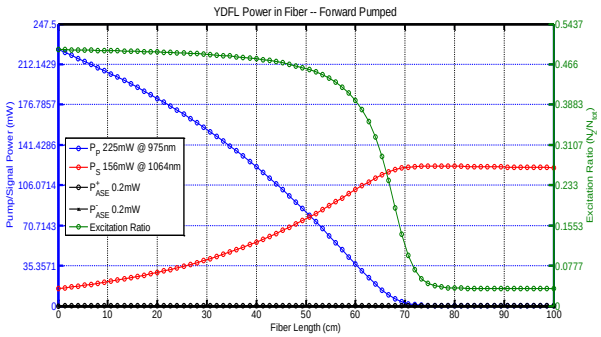

Figure 16: YDFL Power in Fibbers

Pump power remain constant till nearly 65cm and then decreases sharply and signal power increases as the length of fiber increases and become constant after 65 cm.

F. Resonator Type: Linear

Figure 17 gives the reflectance of output coupler and pump power. As the reflectance increases the required pump power decreases. But its efficiency is nearly 3times more than EDFL but 50 less than ring resonator of YDFL.

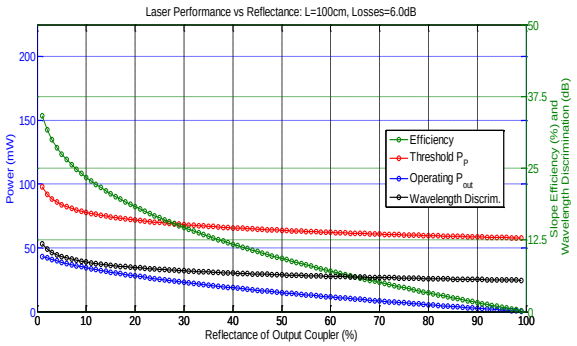

Figure 17: Reflectance of Output Coupler vs Power

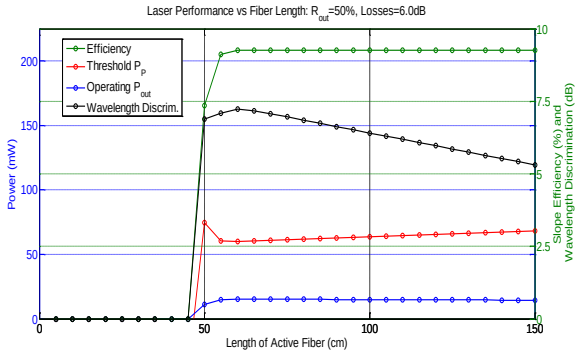

Figure 18: Laser performance vs Fiber length

With forward pumping the efficiency of the laser remains constant for entire fiber length as shown in figure18.

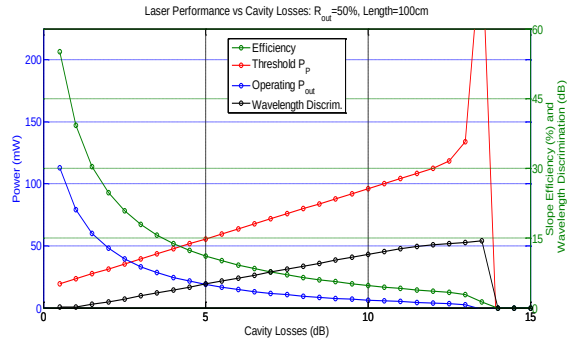

Figure 19: Laser Performance vs Cavity Losses

As the cavity losses increases the power and efficiency decreases.

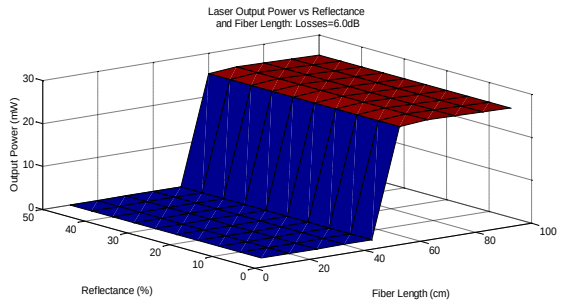

Figure 20: Laser Output Power vs Reflectance and Fibber Length

Laser output power, reflectance and fiber length is shown in figure 20.

The output power of YDFL is 25mW which is better than EDFL which gives 10mW. The YDFL gives better output power then EDFL. Ring resonator is better than linear resonator.

Table 3: Output Power Comparison

EDFL	Linear	10 mW
	Ring	20 mW
YDFL	Linear	25 mW
	Ring	40 mW

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

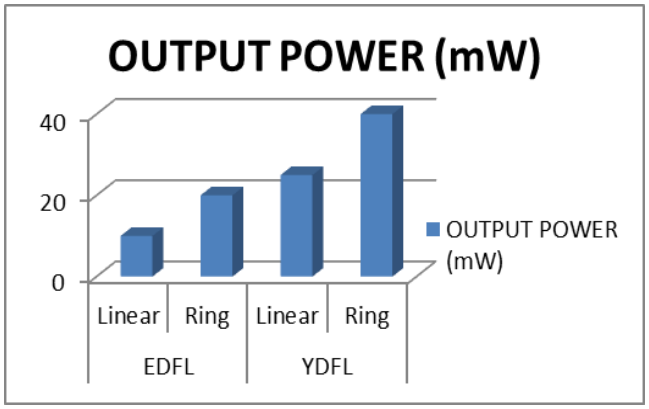

Figure 21: Laser Output Power

III. CONCLUSION

The system has been designed to analyze the gain and pump power and output power dependence of the optical laser EDFL and YDFL for various fiber lengths. The output power of YDFL in ring resonator is 40mW and in linear resonator is 25mW, which is better than EDFL which gives 20mW in ring and 10mW in linear. The YDFL gives better output power then EDFL. Ring resonator is better then linear resonator.

REFERENCES

1. Pedro João, Costa Nelson. Optimized hybrid Raman/EDFA amplifier placement for DWDM mesh networks. J Light Wave Technol, IEEE 2018;36:1552–61.
2. Barth Ido, Fisch Nathaniel J. Multifrequency Raman amplifiers. Phys Rev E 2018;97:1–6.
3. Zhou Peng, Zhan Wenhui, Mukaikubo Masaru, Nakano Yoshiaki, Tanemura Takuo. Reflective semiconductor optical amplifier with segmented electrodes for high-speed self-seeded colorless transmitter. Opt Exp 2017; 25:28547–55.
4. Curran, G.L. and Engelken, D.J. (1990) Ring Laser Gyro Applications for Tactical Missiles: The Army TACMS Solution. Position Location and Navigation Symposium, IEEE PLANS '90, IEEE Digital Object Identifier, 543-548.
5. Canales, P., Meshal, A., Ricklin, J. and Vallestero, N. (1990) Bandwidth Enhancements for the Army Network through Laser. Aerospace Conference. 2004 IEEE Volume: 3 Digital Object Identifier.
6. Alvarez-Chavez, J.A., Cruz, M., Martinez-Rios, A.L., Torres-Gomez, I. and Martinez-Pinon, F. (2006) High Power Er3−/Yb3+-Doped Fiber Laser Suitable for Medical Applications. Electronics and Photonics. Multiconference on Digital

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)