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A REVIEW OF OPTICAL FIBERS FOR DAYLIGHTING

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***Abstract*—**Optical fibers have a variety of applications like communications, sensors and lighting purposes. Daylighting is an application of optical fiber where it is used to transfer visible solar spectrum into rooms or study halls. The use of solar lighting in rooms is a very old concept which has generated the constructional idea of windows and blinds.

***Key Words*—**Daylighting, Optical Fiber, Solar Lighting.

1. INTRODUCTION

Daylighting systems which bring sunlight into rooms are available in the market like Solatube [1], Parans [2] and Himawari [3]. These systems use different techniques for transporting light. Solatube system uses a hollow tube to transport light, Parans system uses polymer fiber to transport light and the Himawari systems use special quartz fiber to transport light.

Though the concept of daylighting seems to be simple, the systems are not advanced enough to replace existing electrical lighting systems. Reasons being, the systems cannot give light at night or other low lighting conditions. Even during the day, the efficiency and present cost of the systems are not practically suitable for widespread deployment. Research is in progress to address these issues. A comparison of polymer fiber with silica fiber is reported in [4] for daylighting application. An improved solar collector is reported in [5].

This article reviews the basic fundamentals and different designs of daylighting systems reported in literature and available in the market.

2. REVIEW OF DAYLIGHTING SYSTEMS

The basic requirements of any daylighting system would be efficient solar collection, distribution and diffusers. The Solatube system shown in Fig. 1 does not use a fiber. It uses a light guiding tube of Aluminium to transport light. Though suitable for most applications, the major drawback of this light guiding mechanism is its lack of flexibility, which reduces the ease of distribution.

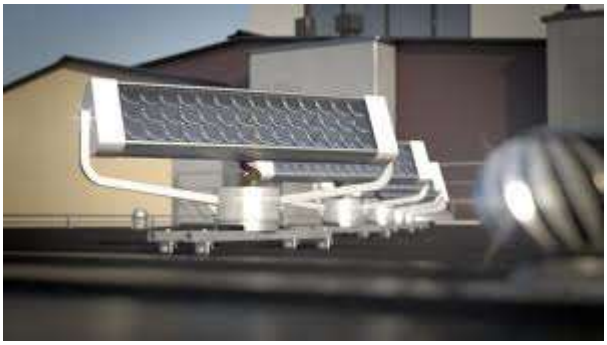

Figure 1. Solatube daylighting systems use multiple reflections in a tube.

The Parans system uses a collector shown in Fig. 2. Light from the collector is coupled into a Poly Methyl Methacrylate (PMMA) fiber for distribution. The fiber makes it simple and easy to distribute the light to different locations. Different types of diffusers are available depending on the necessity of use. Some of the diffusers are shown in Fig. 3. The major disadvantage of the Parans system is the use of PMMA fiber, which has a very high loss with distance covered.

Figure 2. A Parans collector which couples light onto PMMA fibers.

Figure 3. Different types of Parans diffusers.

The Himawari system has an efficient solar collector shown in Fig. 4. It uses a special type of quartz fiber, which is claimed to have a very low loss.

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Figure 4. Himawari collector showing its sun tracking ability.

All the systems have the feature of collecting maximum sunlight, but the Parans and Himawari systems use active tracking which again needs electrical power.

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BIOGRAPHY

Dr. M. Ravi Kumar was born in Jatni, Odisha, INDIA on 14th January 1979. He has obtained his B.E. in Electronics and Telecommunication Engineering from Utkal University in 2000, M.Tech. in Opto-Electronics and Laser Technology from Cochin University of Science & Technology in 2005, and Ph.D. from IIT Kharagpur in 2011. He is currently working as Assistant Professor in IIIT Bhubaneswar and had worked as an Assistant Professor in GITA. He has published 5 research articles in international journals and conferences. His research interests include optical communications, integrated optics and daylighting systems. Dr. Kumar is a member of IEEE and Photonics Society of India. He is also a reviewer for Optics Express.