FUTURE POTENTIALS OF SMART MATERIALS IN CONSTRUCTION INDUSTRY

Priyanka Dixit[1], Ajma Kausar[2], Prof.N.K.Dhapekar[3]

[1]Lecturer(KITE),
[2]Lecturer(KITE)
[3]Hod Civil Engineering(KITE),
E-Mail:-Profdhapekar@gmail.Com

ABSTRACT

Smart materials are materials that "remember" configurations and can conform to them when given a specific stimulus. These materials can respond to changes in electricity, heat, or magnetic waves. They are able to perceive and feel the stimuli from the environment as well as from their inner, to react on stimuli and adapt to them by integration of functionalities in their structures. In construction, smart materials and systems could be used in „smart" buildings, for environmental control, security and structural health monitoring e.g. strain measurement in bridges using embedded fiber optic sensors. Magneto rheological fluids have been used to damp cable-stayed bridges and reduce the effects of earthquakes With the advent of advanced technology, smart materials are used in various civil engineering applications and across a wide range of other sectors including agriculture, aerospace, marine, food and packaging, healthcare, sport and leisure, energy and environment, space and defense using embedded fiber optic sensors.

Keywords: *Actuators, intelligence, sensors, smart materials, specific stimulus*.

1.Introduction

Historical ages are often referred to in terms of material age such as, Stone-age, Bronze-age, Iron-age etc. The present age is considered to be the age of flexibility of choice of materials. Scientific and technological developments have given us numerous advanced and novel materials and their applications, and any one single material, therefore, can not characterize the present age. Today, due to the scarcity of suitable construction materials, the primary concern of engineers is to explore the new advanced materials which find their bulk utilization in various engineering applications. For the development of such innovative materials and their use, the engineer has to select the most appropriate technology, he must know what properties should be considered, how these are determined, what are their limitations, and should intelligently select the right material for appropriate use. These predictions are not the result of gazing into a crystal ball, but are based on an appraisal of current research in leading materials laboratories around the world.

The "smart" or "intelligent" materials respond with a change in shape upon application of externally applied driving forces. Typically this shape change is reflected in an elongation of the sample, thus allowing their use e.g. as a small linear motor. The term "smart materials" describes a group of material systems with unique properties. Some materials systems do not exhibit a shape change, but rather have other significant properties are also called smart materials. Examples of "other" smart materials include electro- and magneto theological fluids. These fluids can change viscosity over many orders of magnitude upon application of an external magnetic or electric field.

Types of Smart Materials: Smart/Intelligent structure applications are wide ranging from active shape control, vibration and noise control, improved damping and aero elastic stability to change stress distribution. The various types of smart materials used in smart structures are as listed below.

- Piezoelectric Materials (PEM)
- Fiber optics
- Shape Memory Alloys (SMA)
- Electro-Rheological Fluids (ERF)
- Magnetostrictive Materials
- Electrostrictive Materials

2.Smart Structure

Adaptive Materials and to some extent actuators and sensors are almost always used interchangeably. This can sometimes lead to confusion as different terms can really describe the same effect or property of a material. To add to the confusion the terms smart devices, smart systems or smart structure are often carelessly used. Here one should note that in general the system complexity increases from the unit material to device‖ to systems to structures. Any permutation of the adjective (smart, active) with the subject (material, device) is more or less meaningful and seems to have been used already in one way or the other in published reports and papers. Much more important than the actual word definition is the general understanding of the field.

3.Application of Smart Materials in Engineering & Allied Sectors

Smart materials find a wide range of applications due to their varied response to external stimuli. The different areas of application can be in our day to day life, aerospace, civil engineering applications and mechatronics to name a few. The scope of application of smart material includes solving engineering problems with unfeasible efficiency and provides an opportunity for creation of new products that generate revenue. Important feature related to smart materials and structures is that they encompass all fields of science and engineering.

3.1 Structural Health Monitoring: Embedding sensors within structures to monitor stress and damage can reduce maintenance costs and increase lifespan. This is already used in over forty bridges worldwide.

3.2 Self-Repair: One method in development involves embedding thin tubes containing uncured resin into materials. When damage occurs, these tubes break, exposing the resin which fills any damage and sets. Self-repair could be important in inaccessible environments such as underwater or in space.

3.3 In Structural Engineering: These materials also find application in the field of structural engineering. They are used to monitor the civil engineering structures to evaluate their durability. Not only the smart materials or structures are restricted to sensing but also they adapt to their surrounding environment such as the ability to move, vibrate and demonstrate various other responses. The applications of such adaptive materials involve the capability to control the aero elastic form of the aircraft wing to reduce the pull and improve operational efficiency, to control the vibration of satellites‘ lightweight structures, Smart structures are also being developed to monitor structural integrity in aircraft and space structures. Effort has been made to investigate certain piezoelectric materials to reduce noise in air conditioners.

Besides, in civil engineering, these materials are used to monitor the integrity of bridges, dams, offshore oil-drilling towers where fiber-optic sensors embedded in the structures are utilized to identify the trouble areas.

4.Conclusion

The technologies using smart materials are useful for both new and existing constructions. The many emerging technologies available, the few described here and need further research to evolve the design guidelines of smart structures. Codes, standards and practices should give crucial importance for the further development of smart structures using smart materials.

1. Smart materials are not only useful but also cost effective as compared to conventional materials for both new and existing constructions.
2. The potential future benefits of smart materials, structures and systems would prove amazing in their scope.
3. Smart technology and smart materials gives promise of optimum responses to highly complex problems.

5.References

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