

Letter to the Editor:

"Non green perspective on biodegradable polymer nanocomposites" - A comment on 'A Review on Carbon Nanotubes in an Environmental Protection and Green Engineering Perspective' published in *Braz. J. Chem. Eng.* 27(2), 227-242 (2010).

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Dear Editor,

This is a comment on a recently published (Ong, Ahmad, Zein, & Tan, 2010) article, 'A Review on Carbon Nanotubes in an Environmental Protection and Green Engineering Perspective'. Recent developments in carbon nanotube (CNT) applications in sustainable technologies were discussed. This article points out some interesting features of CNTs in pollution control, wastewater treatments, renewable energy and biotechnology. Apart from these, the use of CNTs in nanocomposite preparation is of interests. Especially the terminology 'green' draws attention of the readers. It is argued that the incorporation of carbon nanotubes into biodegradable polymers make the nanocomposites 'green'. Polymers synthesized from biobased renewable sources may or may not be green depending upon their intensity of toxicity and harmful effects on living beings. But, the addition of carbon nanotubes into safe polymers actually makes those polymers less safe and thus less green than base polymeric material. This is because the scientific terminology 'green' is based on the safe, non-toxic nature of the products or the manufacturing process. According to the experts, the term 'green' is based on the reduction or elimination of the use or generation of hazardous substances in the design, manufacture and application of chemical products (Anastas & Eghbali, 2010). For this purpose, the founders of the term 'green' introduced two types of principles (Anastas & Eghbali, 2010).

1) "12 Principles of Green Chemistry": These principles emphasize pollution prevention, design of safe chemistry, use of safe solvents, catalyst use, renewable resources, energy efficiency, waste minimization, atom economy, safe chemical design, use of safe synthesis methods.

2) "12 Principles of Green Engineering": These principles are equivalent to the principles of green chemistry but focus on the process instead of products.

In addition to this, software based online tools such as "iSUSTAIN™ Green Chemistry Index" are being introduced for the studies that focus on green aspects of the products or processes.

The concerns of unexplained use of the term 'green' are being reported (Fegade, 2015; Fegade, 2015; Winterton, 2011). In the manuscript, especially in the section 'Carbon Nanotubes in Green Nanocomposites' there is no explanation of the safe, non-hazardous nature of the nanocomposites. The

'green engineering perspective' as appears in the title, is also not defined/explained throughout the manuscript. Hence a scientific question being raised for the article in question is: "what makes the carbon nanotube based composites 'green'?"

Aforementioned discussion indicates that the use of the term 'green' is not appropriate for carbon nanotube based composites because of the evidence of toxicity and hazards of carbon nanotubes (Ma-Hock *et al.*, 2009; Muller *et al.*, 2005). However, the term 'sustainable' is appropriate for CNT based nanocomposites. Sustainability is defined in general as: "the development that satisfies the needs of the present without making any compromises in the ability of future generations to meet their own needs". I strongly encourage the readers and authors to understand the difference between topical terms 'green' and 'sustainable'.

References

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