THE FUTURE OF PLASTIC AND OTHER POLYMERS

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INTRODUCING THE NEXT STAGE OF PLASTICS AND POLYMER ENGINEERING

Plastic is a vital material in the modern world. We use rigid plastics in our vehicles because it provides a light yet sturdy substance that can keep us safe and absorb the impact from an accident. We use softer more moldable plastics to hold our unnecessary amount of left-overs after Thanksgiving in something called “Tupperware”. The point is, plastic is used for a wide variety of things because of its easily changeable properties. What we do not realize is that plastic is running out. Plastic comes mainly from a polymer known as Polyethylene. This polymer is derived from chemicals that come from the mixture we know as “crude oil”. As we all know, crude oil is not an unlimited source of material. According to a British energy company, “…fossil fuel reserves are finite - it's only a matter of when they run out - not if” [1]. One day, possibly in my lifetime, the world’s oil supply will be gone. While no oil may mean bad news for our cars, it will not give rise to the end of plastic. In the last decade, companies such as Braskem™ have created the first “green polymers” derived from sugarcane. This process creates the exact same chemical, and hence, the exact same plastic. Best of all, it is a sustainable and renewable process.

THE PROBLEM WITH PLASTIC AND OTHER POLYMERS

Plastics are derived from a class of compounds called polymers. Polymers are super long molecules comprised mostly of carbon. The traditional way to create polymers is to synthetically derive them from crude oil, the same stuff that creates gasoline to power our cars. Lots of work has gone into make these processes cheap and economically sensible.

It is no secret that at some point in the future of human kind we are going to run out of crude oil. It is safe to say, if we run out of oil, we run out of plastic. Plastic is something that the world has come to greatly take advantage of. It is a common item in the modern day. According to a website sponsored by the Indian Ministry of Environment, “Plastics have molded the modern world and transformed the quality of life. There is no human activity where plastics do not play a key role from clothing to shelter, from transportation to communication and from entertainment to health care.” [2]. Clearly, the world would be a very different place without plastic or some kind of material like it.

It has unique properties as a material. It is very versatile uses because it is easily manipulative by using different processes and additives. Because of this, we as a society have invested so much into its use. If we were to “run out”, it could be detrimental. Fortunately for us, there is a solution to this problem. The end of oil does not mean the end of polymers and plastic because there are new ways to create plastic. Currently, most polymers are created synthetically, but we are now seeing the rise of “green” polymers.

THE TECHNOLOGY OF GREEN POLYMERS

Today, there is already a large growing business in the creation of green polymers. Polymers have to meet certain requirements to be labeled “green”, one being that they come from a sustainable renewable source, which in this case is called biomass. According to an article in the Macromolecular Journal, “Exploiting biomass as a renewable resource for making renewable oil, green coal, gas, monomers, and renewable polymers without a delay of many million years typical for fossil raw materials” [3]. This is what is so attractive about green polymers. In a way, it is the same process used for creating polymers but instead of using oil, biomass, a renewable source, is the starting point.

Both the oil-based and biomass-based processes normally produce the exact same chemicals. Therefore, there is no need to worry about loss of integrity or change of properties that comes from shifting toward the bio-based polymers. So, the only thing left to do is examine the process behind bio-based green polymers. While there are many similarities between the two, there are some downsides to...
using biomass over conventional oil. The same article from above also states that, “Less favorable energy and problematic ecobalances are typical for biodiesel” [3]. This could be problematic to green polymers advances in the market due to higher prices and economic concerns. However, in many ways I believe that the benefits gained from these processes outweigh the extra costs of production. This process has extra benefits other than creating a green renewable product. Most obviously, it takes away some dependence on oil and its depleting sources. Also, the process used to create biomass captures carbon dioxide and removes it from the atmosphere which solves another growing concern in society. There are numerous outside benefits beyond the product itself. I think this will be an important factor leading the transition to green polymers and their use.

AN EXAMPLE OF GREEN POLYMERS IN USE.

While the green polymer market as a whole is still on the rise, certain green products have already proven to be perfect substitutes to their oil-based twin. A Brazilian based company called Braskem™ has created I’m Green™ Polyethylene. In 2010, Braskem opened its first green ethylene plant; where they process and created polyethylene from sugar cane that they grow on nearby farmland. They have had great success with their product. An article from chemical-technology.com states that “It is the first large-scale ethylene project to use 100% renewable raw materials.” [4]. Green Polyethylene, using the Braskem process, requires no new investments and costs the same as it oil-based analog. According to Dr. R. Rangaprasad, an expert on polymer science, “Ethylene from ethanol is identical to ethylene from naphtha or natural gas, and plastics made from bio-ethylene are indistinguishable from petro-derived resins” [5]. It is, in essence, the same exact thing as its oil based twin. Braskem’s I’m Green™ website also says that Green polyethylene costs the company the same amount of money to produce as conventional polyethylene and the same machines can be used for both products [6]. Green polyethylene is also completely recyclable just like regular polyethylene. At the plant, they process 20,000 tons of green polyethylene per year and they plan on investing in a new plant in the next few years to meet increasing demands [4]. Braskem is now dedicated to providing renewable alternatives to conventional polymers. The only thing that holds them back is the lack of farmland to grow sugarcane. Nonetheless, I believe that in the near future we may see a great reduction, if not disappearance in the use of oil based plastic.

CONCLUSION: THE IMPORTANCE OF GREEN POLYMERS

As a chemical engineer, I am very interested in the field of polymers. It makes up a large portion of possible jobs, 7%-10% [6]. Besides that, I enjoy that field and find the science very interesting. However, without the use of green alternatives, it could be considered a dying field because of its reliance on oil and petroleum. I strongly believe that renewability and sustainability are an important factor when talking about any kind of product. I must be counting on the possibility of renewability because there is a good chance I may be alive when we, as a society, run out of unrenewable sources.

Society as a whole has come to have a great reliance on polymers and they take many different forms with widely changeable properties. More specifically the polymer plastic is used for a number of things because it manipulated to be stiff and strong or flexible and moldable. Without a renewable alternative, if we were to “run-out” of plastic from lack of oil supply, many important devices ranging from cars, to electronics, to life-saving medical equipment would not be available or as affordable.

The market for green polymers, is in many ways, still in the early stages. There is a lot of research that needs to occur before most polymers will be able to be converted to green alternatives. However, in the market of polyethylene or plastic, we have already seen a plausible replacement for the conventional product. I believe that it is our duty to move away from oil and other nonrenewable sources. By creating green polymers, such as Green Plastic, we have come one step closer to creating a sustainable and lasting world.

SOURCES

ADDITIONAL SOURCES


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