Renewable Raw Materials in the Industrial Chemical Industry

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Let’s face it. We live in a world where many of the attitudes are make it, use it, throw it away. If it is bad chemical or waste product we put it in barrels, bury it, pump it down deep, and pretend it is not there. However, as we have started to understand more about the world in which we live, we have become more environmentally conscious. Following this trend are the scientists who work in industry. Because of their work, we now have realistic alternatives for many of the dangerous chemicals and destructive processes that were once used.

With the help of the EPA and other agencies, Green Chemistry has become a reality. There are twelve principles of Green Chemistry that the EPA identifies where the design of the chemical products and processes reduce or eliminate the use and generation of hazardous substances. One such principle identified is “A raw material feedstock should be renewable rather than depleting whenever technically and economically practical.”

By definition, a renewable raw material (RRM) is a material of plant, animal, or microbial biomass, which are based on the photosynthetic primary production and are used by man outside the food and feed area for material or energy production (Jering and Gunther, 2010). According to McLaren and Faulkner, RRM from native crops, trees, and agricultural waste can provide many of the same chemical building blocks, plus others, that petroleum products and other chemical processes cannot provide (2010). From these two statements we see that RRM starts with the natural process of photosynthesis and do not rely on petroleum products.

One such industry to consider is the use of vegetable oils and fats in place of petroleum products for the manufacturing of lubricants and fluids. Lubricants represent the second leading cluster of products derived from plant oils (Jering and Gunther, 2010). There are no set definitions as to what constitutes a “bio-lubricant” but the generally accepted minimum is 50% plant based oil (Bremmer and Plonkster, 2008). Bio-lubricants can be utilized as hydraulic fluids, metal working fluids, grease, two-stroke engine oil, concrete mould release agents, chainsaw oils, and fuel additives (Jering and Gunther, 2010). The use of bio-lubricants can also been seen used in machinery and equipment operating in environmentally sensitive areas like agriculture and forestry, jet skis and snow mobiles in aquatic and nature areas.

Considering the other uses of plant-based products in place of petroleum products, let us look at other types of fluids. In the US, linseed oil and soy oil have replaced petroleum based products that have been used in paints, inks, varnishes, and wood impregnation based products (Bremmer and Plonkster, 2008). In the production of plastics, plant oils are used mainly as a softener in polyvinylchloride and polyurethane (Jering and Gunther, 2010).

From a market use perspective, several countries are well ahead of the United States. In Germany, approximately 15% of lubricants and fluids are plant based and in “Scandinavian” countries it is about 12% (Jering and Gunther, 2010). However, in the US, only 1% of the lubricant and fluid market is considered to come from bio-based sources (Bremmer and Plonkster, 2008). In looking at the global perspective of bio-based industrial products, North America ranks behind Europe and Africa in its volume of use (Jering and Gunther, 2010). Considering our technological place in the world, one would almost expect North America to rank above the continent of Africa considering the number of third-world and underdeveloped industrial processes located there. If anything, this finding demonstrates that North America, and particularly the US, has a long way to
go.

Of course no discussion of bio-based or RRM would complete without discussing ethanol. Ethanol represents one of the most successful uses of RRM the world has seen. As of 2010, less than 10% of world ethanol production for industrial use was produced by chemical synthesis from crude oil or natural gas (Jering and Gunther, 2010). Biotechnical ethanol production is the large-scale fermentation using agricultural biomass as feedstock (sugarcane, sugar beet, or starch plants such as corn), followed by purification of the resulting ethanol by distillation (McLaren and Faulkner, 2010). Ethanol is then used to produce fuels, medicines, colorings, scents, flavorings, solvents, and a host of other products (Jering and Gunther, 2010).

In all of the readings and government reports I saw, cost was never really brought up. Considering the growth of plant based products in place of petroleum, and the fact that the continents of Europe and Africa are ahead of North America in their use and production of bio-based product, cost does not appear to a huge consideration. Considering myself and many people I have spoken to, most of us would be willing to pay a little more for a bio-based product that was considered “green”.

In conclusion, one can see that renewable raw materials from plant based products have a multitude of applications and offer real alternatives for use today. Plant-based lubricants and fluids offer similar and in some cases better performance than traditional petroleum based products. Plant-based solvents and other fluids offer equal performance to those of petroleum based products. Plant based ethanol production now accounts for 90% of the ethanol produced for industrial use.

Works Cited

