Still Small: China’s Bioplastics and Biodegradable Plastics Sector Relies on Beijing’s Support

This is the third in a series of three articles on China's plastics sector. For the first article on how China increases self-suffiency in commodity plastics, click here; for the second article on the use of engineering plastics in China, click here.

With the 12th Five-Year Plan (2011-2015), China’s government has started including environmental sustainability among its main political targets. In the past few years, China has already installed the world’s largest wind power capacity and become the biggest manufacturer of solar panels. These achievements were straightforward, as they did not clash with China’s previously overriding goal of achieving high economic growth.

It is not clear yet to what extent China will be willing to sacrifice some of this growth in order to improve sustainability. However, the 12th Five-Year Plan takes some steps in this direction. For the first time in a five-year plan, China has set a target for the reduction of carbon intensity.

Such a policy will obviously also affect China’s plastics sector. In fact, some related measures already have, such as the ban on free plastic bags enacted in 2008 (which led to a massive reduction in the number of plastic bags produced, and to the bankruptcy of some major producers of plastic bags), or the encouragement of developing polylactic acid (PLA) materials as part of the 2009 stimulus programme.

Ways Towards Greater Sustainability

Before discussing the effect of sustainability targets on plastics in China, let us briefly summarise the ways that plastics can become more environmentally friendly. In essence, there are three major ways for this to happen:

Plastics Recycling

Plastics recycling reduces the amount of petrochemicals needed to make plastics, and at the same time reduces the amount of waste that needs to be deposited or incinerated. China is a major global centre for plastics recycling,

importing more than eight million tons of waste plastics on top of the approximately 10 million tons recovered from domestic sources.
However, this article will not focus on plastics recycling but rather on those approaches aimed at achieving sustainability at an earlier stage of the product life-cycle.

Biodegradable Plastics
Biodegradable plastics are made from traditional petrochemicals or renewable sources but are modified in order to increase their degradability under naturally-occurring conditions.

Bioplastics
Bioplastics are made from renewable biomass such as starch and vegetable oil rather than from petrochemical sources. Bioplastics often are biodegradable, but do not necessarily have to be.

Biodegradable Plastics
Biodegradable plastics are already firmly established in some high-value areas such as medical fibres, where biodegradability is less of a sustainability issue but rather a major selling point, such as suture thread that gradually degrades and gets absorbed rather than having to be removed. There are several different types of biodegradable plastics, including those made from petrochemical sources (eg, polyvinyl alcohol, polyparadioxanone, polycaprolactone, carbon dioxide copolymer), and those from renewable sources (eg, PLA, polyhydroxyalkanoate).
Biodegradable plastics of both types receive substantial political and research support in China. The National Development and Reform Commission has set up a biomass special equity fund, and institutions such as the Institutes of Physics and Chemistry of the Chinese Academy of Sciences, Tsinghua University, and Sichuan University are actively egaged in research.
Sinopec Beijing Research Institute is focusing on poylparadioxanone, particularly on reducing costs and improving production processes. For carbon dioxide copolymer, the technology has already been licensed to a company in Jiangsu province, which has set up a capacity of 20 kilotonnes-per-year for a material that is primarily used in foaming materials, packaging materials, and films.
Despite these efforts, biodegradable plastics still encounter a number of problems such as high cost, difficulties in processing, and inferior mechanical properties. Their market share is very small compared to that of durable, typically petrochemical-based plastics, and will likely only grow if the political support arising from China's sustainability goals will continue.

Bioplastics
As bioplastics are directly made from renewable resources and thus provide sustainability at the earliest possible stage of the plastics product life-cycle, they are expected to be among the biggest winners from China's efforts to move towards a green economy.
To be fair, the sustainability of bioplastics needs to be qualified somewhat. Bioplastics manufacturing still tends to rely on oil as an input factor, for example to run farm machinery or to provide fertiliser. As a result, the resource savings tend to be far below 100 per cent, with different studies for different materials indicating savings from 0 to up to 50 per cent.
However, as bioplastics are generally still at an early stage of development, these figures may improve later, for example by utilising farm by-products as raw materials, shifting to renewable energy to power farm equipment, optimising production processes, etc.
Among the most important bioplastics in China are:

Starch-based Plastics

This is by far the biggest global market segment among bioplastics. Starch-based materials are already commercialised in China. For example, China Green Material has an annual capacity of 32 kilotonnes, mainly for film and packaging applications.

Cellulose-based Plastics
Cellulose-based plastics were among the very earliest bioplastics, but have since lost their importance (though as ping-pong balls are made of this material, this type has a specific relevance in China).

Aliphatic Polyesters
Aliphatic polyesters, eg, PHA (polyhydroxyalkanoates), were already referred to as development areas in the 2009 stimulus programme, and have become the most active area of bioplastics research in China. The material is made by microbial fermentation of sugar or glucose. Two Chinese companies, Ningbo Tianan Biomaterials and Tianjin Green Bioscience, are already engaged in commercial production with annual capacities of eight-10 kilotonnes. Tianjin Green Bioscience states to have established the largest global production base for PHA, while Ningbo Tianan claims to be the leading producer of Poly hydroxybutyrate–co-valerate, a type of PHA.

Polylactic Acid Plastics
PLA plastics are (like PHA) based on the fermentation of sugar or glucose. This initially leads to lactic acid, which is not a plastic material in itself but can be polymerised to give PLA. PLA is similar to standard commodity plastics such as polyethylene and polypropylene, which means that existing equipment can be employed for its processing – an advantage that may speed up its entry into the market.
China's combined total annual PLA production capacity is about 20 kilotonnes, but all the top five local producers have stated their intention to reach capacities of at least 10 kilotonnes, which should result in a rapid expansion of the countrywide capacity. The leading company, Zhejiang Hisun Biomaterials, which was formed in co-operation between the Changchun Institute of Applied Chemistry and Zhejiang Hisun, produces five kilotonnes-per-year of PLA and claims to be the first commercial producer of PLA resin.
PLA is used in packaging, textile coatings, and medical and agricultural applications. Currently, it is primarily driven by government support in the shape of a special fund to aid the research and development of PLA technology.

Polyamide 11
Polyamide 11 is a bioplastic made from natural oil that has been commercialised by French chemicals giant Arkema. Its properties are similar to those of other polyamides and it is not biodegradable, though it requires less non-renewable resources for production.
In China, Suzhou HiPro is currently expanding its capacity from five kilotonnes to 15 kilotonnes by 2012. The Polyamide 11 produced from Suzhou HiPro material is used in automotive and consumer electronics applications. An investment from Bain Capital in the company is an indication of its growth potential.

Still Small
Overall, with some exceptions such as polyamide, the consumption of bioplastics and biodegradable plastics in China is not very large yet. Most of the material produced locally is exported as the materials are priced higher than petrochemical plastics, and China is more price sensitive and has less of a preference for environmentally-friendly materials than Western markets.
In the near future, therefore, the market will continue to depend on political support until the price of such plastics substantially decreases, making them more commercially viable.