TECHNICAL BULLETIN: PE RECYCLE AND BIODEGRADEBILITY

1. Introduction

Actually there is two subjects with development and investigation for the plastic industry as: Recycle and Biodegradability.

The new environment regulations and the world preoccupation by the plastic residues have motive a big investments by the companies to development the biodegradable polymers and obtain a ruler more effective of the residues plastics.

2. Biodegradability

There are biodegradable polymers derived entirely from biological sources such as corn, wood pulp, etc., or may be sintered by bacteria of small molecules such as Butyric Acid or Acid Valeric. There are also oil-based polymers (eg aliphatic polyesters or co-aliphatic-aromatic polyester) and mixed sources from oil and biomass. (1)

The disadvantages of biodegradable polymers are the high cost and poor now have properties that are in some aspects such as: weakness, low heat distortion temperature, high gas permeability, low melt viscosity for processing, etc.. This limits, in a broad range of applications which can be used. For this reason, it has invested large amount of economic resources devoted to research achieve biodegradation of polyolefins such as polyethylene, which is one of the most widely used in applications where biodegradable polymers have great limitations (ej. packaging).

Among the investigations of further moves to degrade polyethylene (PE), are two areas that are currently under development with promising preliminary results:

- PE blends with biodegradable materials (such as starches).
- Use of additives to degrade the polymer.

a. PE blends with biodegradable materials.

Have been tested several mixtures of PE with other biodegradable polymers such as starch from potatoes or cassava (in an amount of 5 to 50%), Polihidroxibutírico (PHB), polihidroxivalereto (PHV) and poly (vinyl alcohol) (PVA).

The main disadvantage is that such mixtures have seen little adhesion between the phases formed, which affects its mechanical properties and decreases the end. Therefore, research is the effect of different types of compatibilizing these mixtures.

Studies of the compatibilizing between PE and starch has been made by Vittoria Balsamo et al. (2) and R. H. Mendoza et al.(3), between high-density PE and PVA by Rosmary Brandalise et al. (4) and between PE and PHB blends was studied by Silvia Martell (5).

In general, they have found techniques and compatibilizing bringing the properties of the blends are higher than each individual component (synergism).

To degrade these mixtures of PE have been experiments that consist of burying the samples in half to promote the degradation and solid waste in any common organic garden.

b. Additives that degrade the polymer

The use of fully degradable materials that can replace the EP is theoretically feasible, but due to the high consumption is that the latter world, this change would result in an investment of resources to achieve this goal.

On the contrary, many companies have decided to invest in developing technologies that can produce degradable PE. One technique is to add additives that promote degradation of the polymer after being used. Additives

have been developed which are thermal and / or UV-degradable and also for so-called oxo-degradable ".

Among the companies that have additives and / or additives used in manufacturing applications of PE are:

- EcoSafe®. www.ecosafeplastics.com: Produce oxo-degradable plastic packaging and biodegradable. (6)

- Willow Ridge Plastics, Inc. www.biodegradableplastics.net: Producing additives based on corn starch (biodegradable) with pro-degrading ingredients used methods for activation and UV oxidation. They also produce other additive packages that make the EP-oxo-biodegradable and UV degradable. (7)

- ECM Biofilms. www.ecmbiofilms.com: It produces a range of additives that claim to be biodegradable and not only UV-degradable, ie, the material required to receive sunlight to power the degradation occurred, indicating that the material is degraded due to bioactive compounds that attract colonies of microorganisms that metabolize and neutralize the polymer. (8)

- Aditivos TDPA™. www.epi-global.com: The degradation caused by the reaction of plastics with oxygen (oxo-degradation) were also initiated by exposure to the rays ultavioleta (UV-degradable), high temperatures and / or mechanical stress. This company ensures that products made from polyethylene (bags of shopping and supermarkets) have shown no toxic materials biodegrade in a range of time from a few months to several years depending on the formulation of the additive. (9)

- Aditivos Addiflex. www.greenclubinc.com: Ensure produce oxo-degradation of the material up to 90%. (10)

- Aditivos D2W®. www.degradable.net: Introduced a package of additives that trigger the degradation of poly-oxo after a preset period of time. Additives are included during the extrusion process. (11)

Metals are often used to start the oxidation of materials. That's why some environmental groups say that these additives can generate toxic waste, in addition to the problem that some kinds of additives, such as those activated by UV and temperature, are not degraded in the absence of media with these factors, for example bags and buried parts to be submerged in deep water as the oceans.

These additives can be prepared so that the polymer degrade in a time of:

- 3 to 6 weeks in special preparations to be buried.
- 3 to 5 years if left on sites such as landfills.
- 5 to 10 years to be biodegraded.

3. Recycled polyethylene

There are mainly two ways to recycle plastics: mechanical and chemical.

a. Mechanical Recycling

Mechanical recycling is the reuse of the product, which involves trailers and melt the plastic and re-used to mold a new form or application. Plastics must be sorted and separated by type (material) before they can perform mechanical recycling. Technologies to introduce the automatic classification of different types of plastics are currently in development.

Identifiers fluorescent

Consists of the optical identification of the types of plastics through identifiers fluorescent material incorporated in small concentrations. (12)

Infrared spectroscopy

Through the technique of infrared spectroscopy have been several studies to increase efficiency and speed of identification, classification and separation of plastics. The research done by Scott, D.M.(13) includes a device to automatically identify and separate the plastic waste through identifier that uses a filter in a two-color near infrared spectrometer.

Recycling process PIM

The company Environmental Recycling Technology plc (ERT plc http://ertplc.com) has developed a process where the mixed plastics, and even with some contaminants such as sand and paper, can be melted and brill in small grains that can be used in the processing of new parts as part kernel of the piece and the surface. (14)

This mixture of materials has been shown to possess good mechanical properties, thermal and sound insulation, as well as being lightweight.

b. Chemical Recycled

Is to break the polymer chains into their constituent monomers, which can then be used again in refineries, petrochemical and chemical production.

Pyrolysis

It is a process where waste is heated in the absence of oxígemo in a closed-down into their basic components.

Studies conducted by NREL (National Renewable Energy Laboratory - USA) (15) have developed a pyrolysis process which can break down certain types of wastes in the monomers that compose them, thus allowing to use these components in the manufacture of new polymers. The advantage of this technique is that the wastes are not required to be classified or separated before being processed by this technique.

Another work in this area has been developed by Buzeta Frabicio et al. (16), who used a fluidized bed reactor where a mixture of HDPE, LDPE and PP could be broken down into compounds such as methane, ethane and propane in gas phase, and benzene and toluene in liquid

Gasification

This technique produces gas that can be used to produce chemicals such as hydrogen, methanol and ammonia. In a first stage low-temperature, hot sand at 600 - 800 ° C within a gasification cavity, then the plastic is introduced into the container where they decompose, and when in contact with the sand, forming hydrocarbons, carbon monoxide carbon and hydrogen. This gas mixture passes to a second stage of high temperature (between 1300 and 1500 ° C) where they mix and react with water vapor to produce mainly carbon monoxide and hydrogen. On leaving the reactor, the gas is cooled quickly to prevent the formation of dioxins.

Recent investigations have developed techniques to gasify wood and mixtures of PE, one of this research was developed by Johannes van Kasteren (17) which could achieve optimum conditions for the gasification process.

Use of waste as alternative fuel

There is discussion of it to use plastic waste as fuel or power generation processes. The incineration of plastic waste is one of the most polluting and harmful to the environment, but to reduce their impact on the environment has also been used as a means of generating power.

On the other hand, have developed techniques and plants that are responsible for producing fuels from waste plastics (ej, RPF (Refused Paper and Plastic Fuel). Several Japanese companies have been devoted to the development of RPF and have formed partnerships of RPF of Japan, consisting of eight companies and nine plants, which are Shinsho Corporation (http://www.shinsho.co.jp/english/tekko-genryo.html) y Sekishouten C.., Ltd. (http://www.sekishouten.jp) who promoted the creation of this association and are the plants with more time spent using these technologies.

It is investing a large sum of money in Japan for the reduction in oil imports towards the use of renewable energy and waste. This type of energy has the added advantage of reducing the amount of CO2 into the atmosphere.

There are other companies such as Amandus Kahl GmbH & Co. KG (Germany: http://www.amandus-kahl-group.de/index.php?set_lang=en), which are also responsible for producing this type of fuel waste.

4. Bibliographic References

(1) Mai, Yiu-Wing y YU, Zhong-Zhen. Polymer nanocomposites. Boca Raton, Florida, USA: Woodhead Publishing in Materials, 2006

(2) Obtención de compatibilizantes para mezclas de polietileno/almidón mediante radiación microondas. Balsamo, Vittoria, Rivero, Ismael y Muller, Alejandro. Lima, Perú: SLAP, 2008. XI Simposio Latinoamericano y IX Congreso Iberoamericano de Polímeros.

(3) Fils of PE/Starch Blends – Degradation of These new Material. Mendoza, R.H., y otros. Rio de Janeiro: Empromer, 2005. Second Mercosur Congreso of Process System Engineer.

(4) Estudio de biodegradazao da mistura HDPE com PVA por processo de compostagem. Brandallise, Rosmary, Zeni, Mara y Martins, Johnny y Forte, María. Lima, Perú: SLAP, 2008. XI Simposio Latinoamericano y IX Congreso Iberoamericano de Polímeros.

(5) Martelli, Silvia. Enviromentally Compatible Polymeric Blends and Composites Base don Oxo-Biodegradable Polyetheylene. Universitá de Pisa – Electronic Theses and dissertation. (En Línea) (Citado el: 25 de Septiembre de 2008). http://etd.adm.unipi.it/theses/available/etd-03082008-200256/.

(6) ECOSAFE Biodegradable Plastic. Ecosafe Biodegradable Plastic. (En Línea) (Citado el 31 de Octubre de 2008). http://ecosafeplastics.com/.

(7) Willow Ridge Plastics, Inc. Willow Ridge Plastics. (En Línea) Willow Ridge Plastics, 2005. (Citado el 31 de octubre de 2008) http://www.biodegradableplastics.net/index1.html.

(8) ECM Biofilms, Inc. ECM MasterBatch Pellets. (En Línea) (Citado el 31 de octubre de 2008) http://ecmbiofilms.com/.

(9) Epi Enviromental Technologies, Inc. Epi. (En Línea) Epi Enviromental Technologies, Inc., 2008. (Citado el 31 de octubre de 2008). http://epi-global.com/

(10) Green Club, Inc. Green Club, Inc. (En Línea) (Citado el 31 de octubre de 2008). http://www.greenclubinc.com/

(11) Degradable Plastics. Degradable Plastics. (En Línea). (Citado el 31 de octubre de 2008). http://www.degradable.net/.

(12) A New Technology for Automatic Identification and Sorting of Plastics for Recycling. Ahmad, S. R. 10, 2004, Environmental Technology, Vol. 25, Págs. 1143 – 1149.

(13) A two-colour near-infrared sensor for sorting recycle plastic waste. Scott, D. M. 6, 1995, Meassurement Science and Technology, Págs. 156 – 159.

(14) Enviromental Recycling Technologies plc. Enviromental Recycling Technologies. (En Línea). (Citado el 31 de octubre de 2008). http://ertplc.com

(15) Laboratory, Nacional Renewable Energy. Industrial Innovations For Tomorrow – Adavances in Industrial Energy-Efficiency Technologies. Washington, USA: s.n., 1993.

(16) Recycling of Polyolefin By Pyrolysis in an Fluidized Bed Reactor. Buzeto, Frabicio, Kaminsky, Walter y Senézio, Joao. Lima, Perú: SLAP, 2008. XI Simposio Latinoamericano y IX Congreso Iberoamericano de Polímeros.

(17) Co-Gasification of Word and polyethylene with the aim of CO and H2 production. Van Kasteren, Johannes M. N. 2, Journal of Material Cycles and Waste Management, Vol. 8.

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