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Recycling the plastic components in today's lead/acid battery

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Abstract

With production facilities first established in 1988 at Villefranche in the Rhone valley, the author's company aims to produce 40 tonnes of polypropylene granules from 50 000 scrap battery cases every day. Following a doubling of capacity in 1991, the company now has an annual sales turnover of 40 million FF and an output of 10 000 tonnes which makes the operation one of the largest in Europe for the production of recycled polypropylene. The technology developed and used by the Company enables the process to separate, reclaim and produce high-quality constituent materials that are suitable for use by the automotive industry at a price competitive with virgin materials. The new line, installed in 1991, has enabled the Company to add glass-fibre, rubber and other materials into the recycled product to prepare special types of high-quality material with added value. The overall process is carefully controlled and should soon be certified to ISO standard 9002.

Introduction

Since its discovery by Planté in 1859, the lead/acid battery has been undergoing a continuous evolution, both in the choice of its component materials and in the nature of its design. Until the 1980s, the active part of the battery was contained in either a bakelite or an ebonite box. Today, it is generally housed within a polypropylene casing that is able to resist both very low temperatures, as suffered in northern countries, and very high temperatures, as experienced under the bonnet of vehicles during summer periods. With batteries of present design, polypropylene represents about 4% of the total battery weight. It should be remembered, however, that not all battery containers are constructed from polypropylene. It is likely that when bakelite and ebonite are no longer used, the polypropylene component will constitute about 6% of the global weight of lead/acid battery scrap.

Since 1982, Penarroya has been interested in the recovery of the plastic components of lead/acid batteries. Consequently, in order to achieve an optimum return from polypropylene sources that emanate from secondary lead smelters, Cookson Industrial Materials (UK) and Penarroya (now Metaleurop after the joint venture with Preussag Metals) decided, in 1988, to create a joint venture: Cookson Penarroya Plastiques (C2P).

Metaleurop provides the source of material since the company owns five lead smelters: two smelters in France (one located in Villefranche sur Saône, near Lyon, the other near Lille), one smelter each in Germany (Oker, near Goslar), Belgium and Morocco. The polyropylene coming from the Metaleurop smelters is treated by

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C2P in Villefranche sur Sâone. These sources represent about 70% of the scrap supplies that are processed by C2P. The remaining 30% originates from other European lead smelters (i.e., in France, Switzerland, Spain). Villefranche sur Saône, situated at the crossroads of Europe, provides an excellent communication network.

Industrial know-how serving the environment

C2P is the European leader in the recycling of polypropylene from automotive battery containers. Each day, two production lines are able to treat more than 40 tonnes of the polypropylene scrap that is obtained from the crushing of 50 000 battery containers. This means that every year 40 000 m^3 of battery scraps do not have to be dumped. The benefit, in environmental terms, is considerable. The production process employed by C2P is also environment friendly. It incorporates fully controlled effluent-treatment and closed-circuit water-cooling systems.

The capacity of the operation was doubled in 1991. As a result of this, the present cash turnover is 40 million FF and, at 10 000 tonnes per annum, the output constitutes nearly a third of the European market.

Particular attention is paid to the development of treatment techniques, as well as to the selection and separation of the components. This is essential in order to achieve a level of quality that can challenge the raw-materials market.

The C2P process

The C2P process sorts worthless from valuable (i.e., polypropylene) materials. It therefore separates efficiently the various plastic materials from each other (e.g., acrylonitrile/butadiene/styrene, polyvinylchloride, bakelite, ebonite, polyurethane, poly(methyl methacrylate).

There are four sorting stages (Fig. 1) together with one for washing and one for drying. The latter is performed by means of a centrifuge and pneumatic transport by a warm-air stream. Sorted polypropylene particules are then plasticized and mixed with additives for stabilization and colouration to produce pellets. After homogenization, the granules are sampled for quality control and finally stored in a silo or packaged in large or small bags.

Quality — a priority

The process is strictly controlled. Quality Manual Assurance and Procedures have been implemented to obtain the ISO 9002 accreditation by AFAC (a French association for quality assurance). Throughout the production line, the products are monitored to ensure constant quality and compliance with the specifications. All quality controls are performed in-house. The plant laboratory is equipped with facilities for measuring the rheological, physicochemical and mechanical characteristics of the processed material.

Marketing

Because recycled products are not yet well-known and are not in general use, the marketing strategy of C2P is aimed at three targets: (1) the automotive industry; (ii) horticulture, and (iii) technical applications.

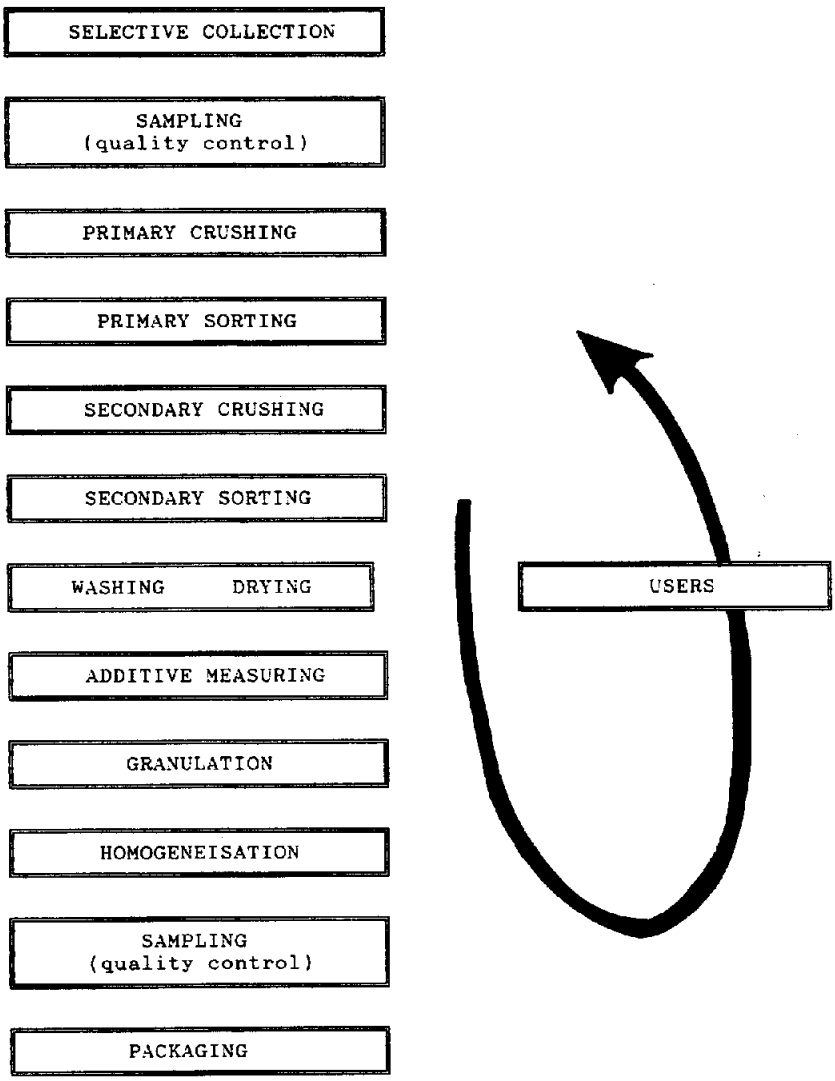

Fig. 1. Processing of polypropylene scraps at C2P.

Automotive industry

The average life of an automobile is about ten years. During every stage of its life, a vehicle produces scraps. These, however, are continually being reduced by car manufacturers. The latter are now collaborating with industrial companies to perfect the original vehicle system, and to anticipate future environmental rules.

C2P, in particular, is already deeply engaged in an active partnership. The company is examining the recycling of polypropylene in the automotive industry in close partnership with Renault and Appryl from Elf-Atochem. This programme has been granted the status of 'great innovating programme' (GPI) by the French Ministry of Industry who, in turn, has provided financial support. C2P has developed a mobile unit that is able

to crush the polypropylene automotive spare parts on site. The scraps are then brought to Villefranche for treatment. Major European car manufacturers have approved various grades of the reclaimed polypropylene, in particular for the moulding of inner-wheel arches. Thus, new automotive parts can now realized from automotive scraps.

Horticulture

With the advent of reactive extrusion that, in particular, allows modification of the fluidity of the polypropylene from the battery containers, high melt-indexes can now be reached. The latter are especially suitable for thin-walled mouldings such as those employed by horticultural containers ('plant pots'). Also, the desired colour is faithfully reconstituted. Granules can thus be produced in grey, black, brick and brown colours for this application.

Technical applications

The know-how of C2P in the field of compounds allows the production of modified grades of EPDM (thermoplastic rubber). These match perfectly the specifications of technical applications. Talc, carbonate and glass-fibre filled grades are very rigid and are used in the processing of plastic materials. Standard grades, in which the rheology is controlled, are available in a large range of melt-indexes, namely, 4 to 40. All the products are available in various colours. It is not yet possible, however, to produce pastel shades.

Conclusions

The cost of the technological effort described above will not be retrieved in the immediate future. This is because the process is being developed during a particularly difficult time for business. Indeed, the polypropylene price has fallen: it has declined from 7 FF per kg during the Gulf War to 4 FF per kg in 1992. At present, prices are appearing to increase, but it is not known for how long this situation will continue, especially given the fact that there are 17 producers of virgin polypropylene in Europe alone.

The C2P effort is compatible with current environmental issues. In this respect, C2P is a pioneer in the field of plastic-materials' recycling. As a result of the expertize gained from purifying and recovering the polypropylene from battery containers, C2P is now turning its attention towards other sources of polypropylene scrap, such as used car bumpers.

It is the contention of C2P that the dumping of scraps will be always more expensive than recycling and that retrieval of some of scraps will even yield profits. In future, however, it will be necessary to improve automatic sorting techniques. Furthermore, the courage must be found to deal with scraps that sometimes exist in a very contaminated condition.