Size Reduction of Technical Plastics - Two-Stage Operations more Efficient than Single-Stage

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At HKR Kunststoffe GmbH in Langenbeutingen, technical plastics such as ABS, PBT, PC, POM, but primarily PA 6, PA 6.6, PA 12, PPA, LCP, etc. - particularly glass fibre reinforced types - are processed into high-grade regranulate. These materials accumulate as production waste in the plastics processing industry in the form of start-up chunks, sprues, rejects, etc. They are treated in two-stage size reduction machines comprising a pre-shredder and a reshredder (Photo 1) made by WEIMA Maschinenbau GmbH, Ilsfeld. The ground stock obtained from this procedure is then further processed into regranulate for own requirements or customer-specific applications. The total recycling capacity in this size reduction plant is 3,500 t/a.

"Two-Stage" versus "Single-Stage"

Size reduction lines provide the core function of HKR recycling plant for which there are initially two basic layout alternatives on offer:

- For single-stage size reduction, the materials to be shredded are reduced to their final grain size of approx. 3 - 10 mm in one step using cutting mills. To ensure that bulky parts can be granulated, whilst at the same time achieving a satisfactory throughput, these cutting mills must have appropriately large dimensions and be equipped with the necessary driving power.

- In the case of two-stage size reduction, the materials to be processed are first pre-shredded using Type WLK single-shaft shredders to a grain size of approx. 40 mm. Compact downstream reshredding or cutting mills subsequently reduce this preliminary material to its final grain size of ca. 3-10 mm.

Photo 1: Two-Stage Size Reduction with Universal WLK Shredder and NZ Reshredder, arranged above each other

More Efficient Process with Two-Stage Size Reduction - Lower Noise Level

To ensure trouble-free size reduction, cutting mills require a constant, uniform infeed that is extremely difficult to achieve manually. If the charging rate is too high, this will frequently cause an irregular, undulating shredding process - at a relatively high noise level - and may result in a material build-up, or even thermal damage to the material to be shredded due to friction. In addition, single-stage processes are more susceptible to interference and generally cause higher wear on the blades, making frequent blade replacement necessary.

In contrast to this, two-stage size reduction allows for irregular charging of the pre-shredder, with the hopper serving as a buffer. This type of infeed significantly optimises the overall production sequence, because the cutting mill does not need to be operated continuously and personnel can therefore also deal with other tasks in between charges.

The pre-shredded feedstock is conveyed in metered quantities to the Type NZ reshredder, which at the same time controls the pre-shredder by means of a stop-and-go switch. The two size reduction units can be positioned either above or in-line. The reshredder functions on the cutting mill principle and is specifically designed for pre-shredded granulate. In comparison with conventional cutting mills its dimensions are much more compact, as a result of which lower driving power is generally needed. Uniform charging results in smooth, uninterrupted operations at a speed of ca. 450 min-1. Even if a cutting mill is used for size-reducing pre-shredded ground stock, the noise level is still much lower in comparison with single-stage processing at the same speed (n=450-500min-1).

Top-Quality Feedstock

Metallic impurities in the pre-shredded feedstock can be removed using a metal separation unit integrated into the interconnected conveyor belt. This brings about a considerable reduction of wear and/or unnecessary damage to the reshredder, consequently allowing a much longer blade life and screen life as well as a much lower rate of abrasion. The dust proportion in the feedstock is also significantly reduced, since the overall material processing time leading up to the desired grain size is much shorter in two-stage operations than in the single-stage variant.

High Flexibility

All in all, two-stage shredding systems permit greater flexibility and also allow for the installed components to be operated individually, depending on the task in hand. A pre-shredder can, for instance, be combined with several

Photo 2: Single-Shaft Shredder, Series WLK – Screw-Type Shaft Journal

Photo 3: Single-Shaft Shredder, Series WLK – Rotor with Hardox Plating
(In-house photos: WEIMA Maschinenbau GmbH, Ilsfeld)

small reshredding units that are then utilised for recurring colours or materials and therefore do not always have to be thoroughly cleaned. It is thus possible to process smaller lots of high-grade plastics more cost-effectively on the smaller reshredders and, at the same time, to significantly reduce maintenance and cleaning costs in comparison with larger machines. As a further option, a pre-shredder can also be combined with a cutting mill that is already in use at the operating company to constitute an efficient two-stage facility.

Robust - WLK Universal Size Reduction Plant

The advanced versions of our Series WLK single-shaft size reduction units are equipped with rotors with screw-type shaft journals on the drive side (Photo 2). This screwed connection permits the journal of the shaft to be subjected to hardening prior to use. The subsequent increased hardness makes the journals of the shaft resistant to higher torsional and flectional stressing and thus greatly prevents wear and damage during use.
The rotors are manufactured from solid steel and can be optionally armoured with highly wear-resistant Hardox plating for shredding abrasive materials such as glass fibre reinforced plastics or contaminated agricultural foils (Photo 3).

The managing partner of HKR, Klaus Dieckmann, comments: "Our business involves recycling high-grade technical plastics. To ensure that our claims on quality as well as those of our customers are always satisfied, we need machines that can be operated flexibly, dependably and economically. In our experience, two-stage size reduction provides distinct advantages as regards the required investment, the broad range of applications, the quality of the granulate, and in particular where the operating costs for the whole facility are concerned. For example, the costs of wear and tear on the blades can be reduced by approx. 50 percent in comparison with single-stage size reduction using cutting mills. Since 1994 a total of seven size reduction machines made by WEIMA Maschinenbau GmbH have been installed in our plant, tailored to meet our requirements in close cooperation with the manufacturer."

WEIMA Maschinenbau GmbH have been manufacturing size-reduction machines for over 20 years for a wide range of applications, for customers in the plastics, wood working and recycling industries all over the world. The company employs a staff of about 120 and has distribution locations in France, Great Britain and America, as well as over 50 agencies worldwide. The production range includes single-shaft shredders, two- and four-shaft shredders, cutting mills, briquetting presses and machines with accessories.

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Plasticker

A special reprint of the technical report in June 2004 from
www.plasticker.de