In-silo blending improves plastic mouldings

Mark Barton, managing director from **Barton Fabrications**, looks at the impact on silo storage of the increasing pressure for plastic moulders to use more recycled feedstock. Silo manufacturers have contributed to this challenge with the development of improved in-silo blending designs to enhance recycled feedstock homogeneity.

Plastic raw materials including PET, HDPE, LDPE, PVC and PP* can all be recovered from both post-industrial and post-consumer use, however, varying degrees of contamination occurs. Difficulties in mixed plastic separation mean that, after the recycling processes, the regrind material is not homogeneous and varies slightly in composition depending upon the origin of the original recycled materials.

In order to minimise the impact of this material on the product quality of the end moulded product, the recycled material typically needs to be mixed with a significant percentage of virgin raw material. The amount of virgin material varies subject to the application and source of recycled feedstock, but is now down to typically 50%. Larger plastic moulders have invested in new or pre-owned silos to keep recycled material separate from the virgin material. Unfortunately, this is not the end to the problem, as moulding issues can still arise from the variability of the recycled material, which varies from batch to batch. This is particularly important as the ratio of recycled material to virgin material is increased. In order to improve the homogeneity of the recycled material, batches of recycled regrind must be blended prior to mixing with the virgin feedstock.

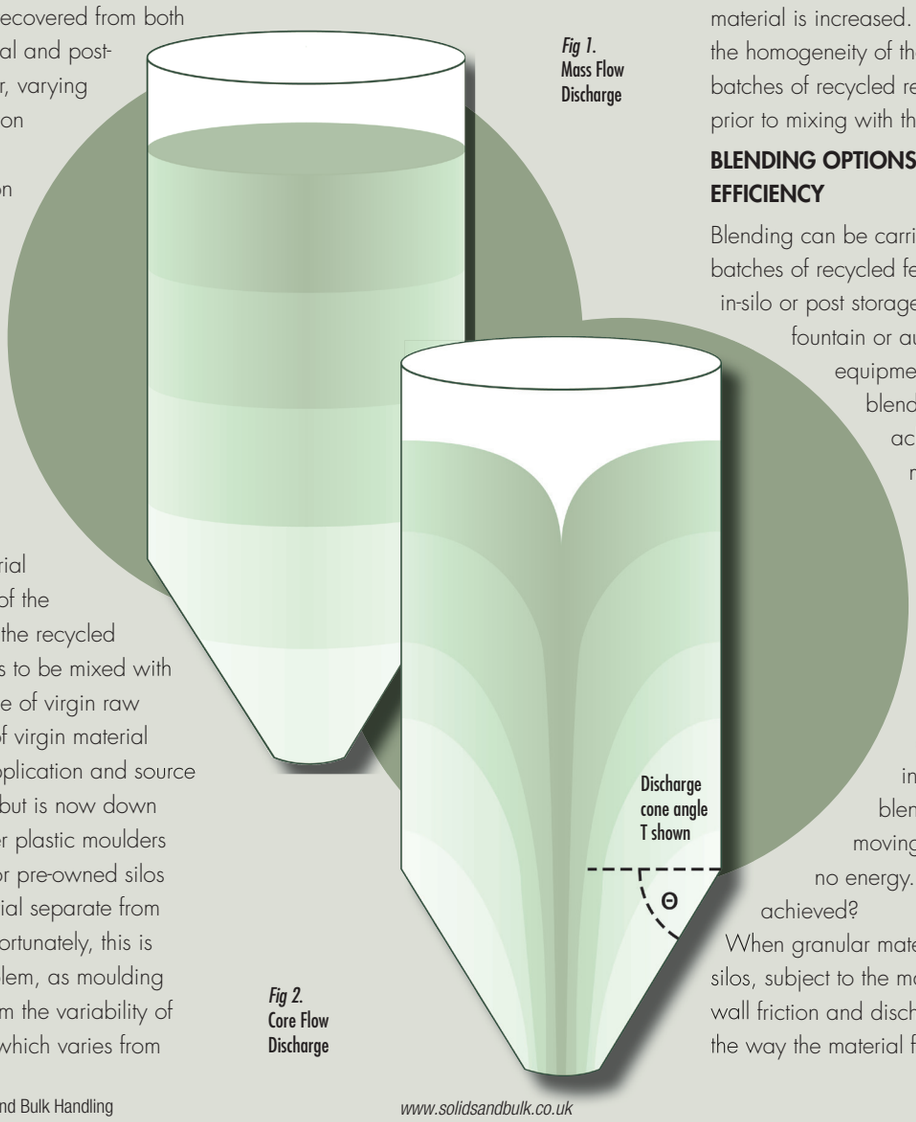

Fig 1. Mass Flow Discharge

Fig 2. Core Flow Discharge

BLENDING OPTIONS AND ENHANCED EFFICIENCY

Blending can be carried out by mixing batches of recycled feedstock prior to, in-silo or post storage using ribbon, fountain or auger design blending equipment. Although high blending efficiencies are achieved using these mechanical blenders, the penalties include extra processing time, higher capital expenditure, additional energy costs and extra maintenance. The alternative is to use in-silo gravity driven blending which has no moving parts and consumes no energy. So how is this actually achieved?

When granular materials are stored in silos, subject to the material properties, silo wall friction and discharge cone angle, the way the material flows out of the silo is >>>

described by either mass flow or core flow. In the former process, the material leaves the silo in the order in which it is filled, so the material at the bottom of the silo leaves first and there is little or no mixing. *See Fig 1*.

For degradable products such as foodstuffs this is desirable to avoid material residing in the silo for too long. For recycled plastic materials the opposite is desirable i.e. maximum mixing of individual batches. If the silo discharge cone angle T is reduced to typically less than 60° ie the cone is made shallower or blunter, the way the material flows from the silo changes. We then see what is described as core flow, where material leaves the silo from a core which rises up through the column of material and is visible as a depression on top. *See Fig 2*. A similar effect can be seen when looking at an egg timer. In this situation the material in the centre section of the silo is mixing vertically. In addition the shallower cone angle is necessary to ensure the smooth flow of plastic regrind material from the silo. This is because the irregular shape of the regrind particles creates more friction than the more cylindrical shape of virgin material.

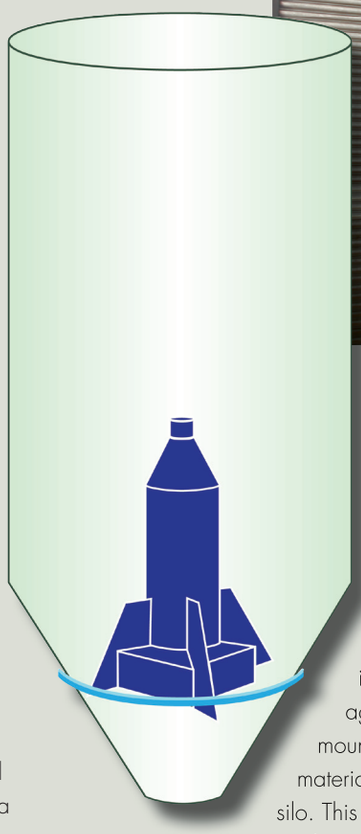

Fig 3. Barton in-silo blender design

There are a number of ways in which silo manufacturers have improved the blending efficiencies of their silos by exploiting and modifying the natural tendency for core flow. By creating rotational flow paths and different zones in which the granular material travels at different speeds, feedstock is taken from different parts of the silo and improves mixing. This has often been achieved using structures incorporating baffles mounted in the bottom discharge cone section of the silo or incorporating a central large diameter tube with different sizes and shapes of holes along its length. Other designs have included smaller diameter tubes, again with different sized apertures, mounted close to the silo wall to ensure material flows from the wall region of the silo. This latter design can be more costly to produce and is more difficult to retrofit.

To achieve optimum efficiency using different existing in-silo blender designs, a solution has been developed by the team at Barton Fabrications. This combines the benefits of the cone baffle arrangement and central tube designs, previously described, and is tailored for each plastic material / application. *See Fig 3 and Image 1*.

The flow dynamics of the raw materials during discharge are extremely complex and different plastics with various particle morphologies behave differently. This therefore needs to be considered during the design phase of the in-silo blender. In order to validate the design prior to silo construction, a model incorporating the actual blender design is constructed, which is filled with batches of raw material. These are coloured differently so that mixing efficiency can be assessed. The silo wall is made of clear acrylic so it is possible to witness the mixing process during silo discharge and confirm mixing efficiency.

Image 1: Barton In-silo Blender prior to final assembly

RETROFIT SOLUTIONS

Many moulders have already purchased new silos to store recycled feedstock as part of their process change to incorporate more regrind raw material. These may have been purchased without blenders i.e. to the same specification as the virgin material silos, which do not suffer from homogeneity problems. To address this issue Barton are able to retrofit in-silo blending units to existing silos on site, subject to review of vessel design and construction.

In summary, where plastic moulders need to introduce / increase the mixing of batches of recycled raw materials, in-silo blending provides a cost effective solution capable of being installed in new or existing vessels. ■

For more information contact Barton Fabrications via its website *www.bartonfabs.co.uk* or call +44 (0) 1275 845901.

The Barton In-silo Blender delivers high mixing efficiency, uses no energy and has no maintenance costs. In addition the Company's blenders can be retrofitted to existing silos to avoid unnecessary replacement costs.

**PET, HDPE, LDPE, PVC and PP PET (Polyethylene terephthalate), HDPE (High Density Polyethylene), LDPE (Low Density PolyEthylene), PVC (Polyvinylchloride) and PP (Polyproylene).*