INDUSTRIAL MANUFACTURING, MATERIAL AND TRANSPORT Technology Offer

Multidune: a hydraulic separator for plastics sorting and recycling (08 IT 55X8 0JE1)

Abstract

An Italian university research group has developed an innovative device, mainly addressed to plastics recycling industry, called Multidune since its shape resembles the undulation of sand dunes. A mixture of plastic particles and fluid is transported through a series of pipes in a similar manner to sand grains travelling in a wind flow. The team is looking for partners, operating in the recycling industry, interested in the further improvement of the process.

Description

In the 'Multidune' separator – so called because its shape resembles the undulation of sand dunes – a mixture of plastic particles and fluid is transported through a series of pipes in a similar manner to sand grains travelling in a wind flow. The device is constructed from a sequence of parallel semi cylindrical tubes of transparent plastic welded together in plane. The lower half is shifted laterally and then fixed relative to the upper half. Flow is then induced in the lateral direction normal to the axis of the tubes creating a main flow channel and two recirculation zones. This apparatus creates a differential transport of particles of low specific mass, near to 1 g/cm3, allowing their separation.

Innovations and advantages of the offer

Separation of plastics in single typologies by traditional processes and devices – such as automatic sorting, electrostatic separation, gravity separation or flotation – is difficult due to their typical low variability in properties.

Automatic sorting is based on optical and morphological properties of plastic materials, e.g., colour and shape. Typically, plastic wastes are stored on the ground as flakes to ease handling, processing or transportation, making automatic sorting difficult. Electrostatic separation employs the differences in tribo-electric charging properties. The presence of contaminant materials in plastic waste decreases the efficiency of such separation process. When gravity separation with traditional static or dynamic separators is employed, difficulties may arise because density differences are very small and presence of extraneous materials. Froth flotation utilizes the difference in surface properties of different plastics. However, in wet processes, the problem of surface tension and low plastic wettability must be faced.

The Multidune separator is a hydraulic separator, allowing solid particles sorting on the basis of differential transport mechanisms, according to particle specific mass. The separation capability of the equipment is strictly related to the velocity field developed within the separation channels. In this regard, image analysis techniques allow the velocity field to be reconstructed given that the apparatus is built in a transparent material, the fluid phase is seeded with neutrally buoyant, highly reflecting tracer particles and a suitable equipment is available to light the fluid and acquire images at the proper frame rate. In particular, Particle Tracking Velocimetry (PTV) is employed to detect tracer trajectories passively flowing within the Multidune apparatus.

Advantages:

The described technology can provide an efficient separation of plastics mixtures composed of typologies with similar properties, allowing to obtain a high value recycled product. This will lead also to a beneficial impact on environmental issue, reducing the waste amount to be disposed.

The fluid dynamic investigation of the Multidune apparatus is a preliminary step to carry out in order to investigate its capability in separating solid particles. The velocity field detected through PTV allows the flow within the Multidune to be divided into three sectors:

- principal transport flow takes place in the first zone,

where the velocity is high. A particle belonging to this region can move from one camera to another;
-the second region is the lower recirculation zone with high values of the vorticity field. Particles belonging to this region undergo the vertical impulse of the fluid. The thrust is proportional to the vertical velocity component and, in conjunction with gravity and buoyancy, determines the destiny of a particle. If the thrust is larger than the net weight of the particle, it will interact with the principal transport flow and, consequently, it will move to the following chamber;
-the third region is the upper recirculation zone whose dimensions are smaller than the other recirculation zone. If a particle moves from the principal flow to the secondary vorticity zone, it will have the chance to come back to the previous chamber, assuming the principal transport flow thrust does not prevent it from falling out.

Current and Potential Domain of Application

-separation of plastics mixture
-recycling industry
-plastic manufacturing industry

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