

# CASE STUDY



**Figure 2: rPET compounded pellets: (a) rPET (Sheet Flakes (50 %) / Virgin PET (50 %), (b) rPET (Virgin PET 20 %)/Bottle 30%)/ Sheet 50 %)**

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## Innovative Recycling technology for Thermoplastic on Twin screw co-rotating extrusion

While South Korea is one of the most developed nations, it has a unique problem that needs to be addressed on priority – disposal of plastics – which is emerging as a major concern. According to a study conducted by Korea Maritime Institute, 990,000 tons of trash are discharged into the ocean by Korea every year and plastics accounted for 20 percent of it. Taking cognizance of the magnitude of the problem, the Korean government announced a plan to reduce plastic waste in the oceans by 60 percent by 2030. At the same time, Korea is determined to ensure that plastic waste discharge into oceans is zero. While these are welcome moves, a paradigm shift is required in the plastics industry to change the mindset of plastic producers. It is imperative for companies producing plastic goods to deliver goods with high component of recyclability, which is nature-friendly.

Technology company STEER Engineering, which specialises in solutions for effectively transforming and functionalising materials in the field of plastics, pharmaceuticals, food & nutraceuticals, biomaterials and plastic recycling, has developed twin screw extruders, which are ideal for recycling plastics. STEER possesses 25+ years of rich experience in extruder technology & compounding applications having installed 900+ extruders globally.

One of the most commonly used thermoplastics is Polyethylene terephthalate (PET) is transparent, resistant to chemicals and solvents. PET has a melting temperature at 260 0C, and good toughness, abrasion resistance at temperature ranging from 150-170 0C. Commercial grade PET intrinsic viscosity [ ] ranges from 0.45 to 1.2 –1. It is used in applications like bottles, containers, fibre clothing, home textiles, curtains, seat covers etc.

When PET undergoes hydrolysis, it results in IV drop and loss of physical properties. Hence, it is important to dry the PET pellets where the residual moisture content should be less than 40 ppm after drying. Due to hydrolysis, PET also go through color change from clear yellow to black depending on the extent of

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degradation. The fraction of rPET in the production of bottles has steadily increased over the year and bottles Manufactured out of 100 % rPET available in the market for consumers.

But PET solid waste disposal has serious environmental concerns and takes more space. It is non-biodegradable and causes serious land filling. In-depth study of PET has enabled STEER to develop innovative recycling technology for thermoplastic on twin screw co-rotating extrusion.

Our twin screw extruder is a beautiful symphony of engineering, design and technology. STEER extruders are a combination of high-performance technology, design thinking and advanced engineering. Every section is designed with a thorough understanding of mixing, materials and outcomes.

STEER's Omega series extruders sets a new standard in the compounding industry. The revolutionary 1.71 Do/Di allows increasing the production capacity by up to 25% due to the



increased volume and torque ability. The OMEGA series comes with STEER's patented 'fractionallobe' special elements that are designed to enhance process efficiency and quality of output, while delivering far greater returns on investment.

STEER has patented 'fractional-lobe' design screw geometry for use in the Omega platform, which is built using the revolutionary 'Fractional- Lobe' geometry, replacing the conventional integer-lobe design. This design eliminates shear peaks and ensures a uniform transfer of energy to the materials being processed, giving the capability

and the control to work with sensitive materials. Besides, it reduces the energy consumed considerably, while improving overall quality.

There are several advantages of using STEER twin screw extruder to recycle plastics. Improved process efficiency and quality due to patented special elements with 'fractional-lobe' geometry allows for higher conveying capacity, uniform shear, and extensional flow. The extruder also offers better control over kneading, stirring and shear to give manufacturers the capability to work with low-bulk density and shear-sensitive materials.

Improved conveying efficiency, greater ROI and minimized downtime due to self-wiping elements that prevent stagnation and degradation, controlled processing with higher required mean shear, reduction in total shear as well as controlled residence time are other advantages that STEER's twin-screw extruders offer.

Another major advantage is quality by design - STEER specializes in "intelligent compounding" technology, which includes the extruder's spline design that allows running high volumes at high torque. In addition, there is the availability of a wide range of specialized mixing elements for processing delicate and heat-sensitive materials. STEER has used complex modeling and algorithms to develop fractional-geometry mixing elements that, compared to other technologies, provide better control of shear and energy input for task-specific applications.

Loss of molecular weight due to shear and hydrolytic degradation resulting in lower intrinsic viscosity (IV) is a matter of importance while working with rPET resin. The applications demand higher intrinsic viscosity and higher mechanical properties. To study the uses of fractional geometry technology to retain intrinsic viscosity in rPoly (ethylene terephthalate) (PET) resin we have used OMEGA 40 twin-screw extruder with L/D of 30 and 36 at a temperature of 200°C to 240°C with the screw speed at 400 rpm which results an output of 250 kg/h. The fractional geometric screw

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configuration resulted in reduced degradation of rPET and retained the molecular weight. This observation was evidenced by IV measurements on Ubbelohde viscometers. Also, Specific Mechanical Energy (SME) and extruder screw speed were recorded from the extruder. There are PC/PBT, PPS/glass fibre and multilayer packaging recycled polymer materials were processed using Fractional geometry technology. The melt formation elements had shorter lead angles increase the frequency of stirring and reduces shear peaks also improves uniformity of mixing.

STEER has mastered PET recycling, including PET sheet, bottle flakes and virgin PET. In addition, STEER technology assists recycling of ABS, PP and PC/PBT with various blend. Adoption of this technology can significantly contribute to recycle of plastics, which otherwise can make a long-term harmful effect on the local ecology. STEER's extruders have a bigger role to play in the Korean plastics recycling industry offering the best of latest technology at competitive prices.

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## About STEER

STEER is a creator of materials platform technologies that transforms and functionalise materials in the fields of plastics, pharmaceuticals, food & nutraceuticals, biomaterials and biorefining. Founded in 1993 by Dr. Babu Padmanabhan with a vision to steer a new world, STEER today has 5 global offices and 10 satellite offices, serving over 39 countries and employs over 500 gifted engineers, scientists and technicians across the globe. With 60 patents for breakthrough innovations, the company is committed to the design, creation and implementation of advanced platform technologies, components, elements, peripherals and applications that help in the creation of safer, stronger, lighter, more sustainable products.

For more information, please visit [www.steerworld.com](http://www.steerworld.com)



MLP / 4% MAHg-PE compound