Simplifying Complex Material Requirements

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EXTRUDERS FROM STEER ENGINEERING

SIMPLIFYING COMPLEX MATERIAL REQUIREMENTS

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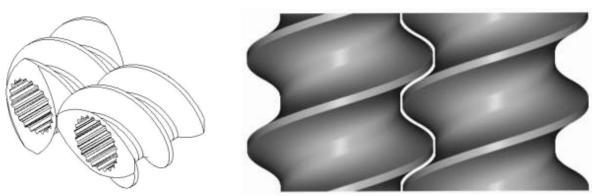
Today, there is a growing emphasis on developing innovative materials that meet customer specifications, cater to novel applications and adapt to the changing technology trends. Founded with the mission to steer a new world, STEER Engineering has significantly contributed to materials development innovations in India. All their efforts are aimed at designing and innovating generation next products & services. Providing more insights on this, Dr Babu Padmanabhan, founder & MD, STEER Engineering, says, "At STEER, we have built a successful business model to help our customers benefit from our wide range of applications and compounding solutions. Today, we have developed an ecosystem geared to drive sustainable growth for STEER's investors and associates, and, of course, continue to drive significant value for our customers."As a leading provider of knowledge based services & solutions to the polymer compounding industry STEER was awarded the most Innovative Plastics Processing Machinery & Ancillary Equipment

CHALLENGE

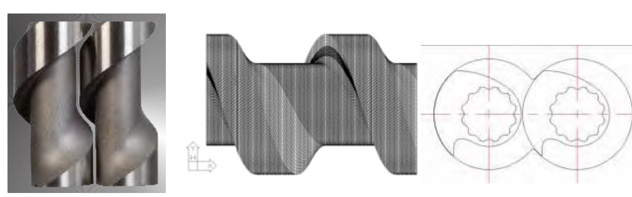
Develop compounders with increased screw speeds and avoid shearing inside the extruder. The existing extruder systems could not handle highly adherent and temperature-sensitive resins, and required constant cleaning. Co-kneaders worked exclusively as kneaders and other functions like metering, dispersion or controlled distribution of fibre needed to be handled separately.

SOLUTION

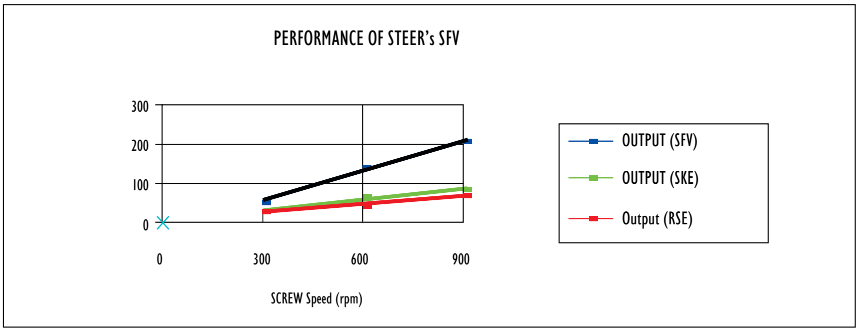
STEER combines the advantage of a dispersive kneader, a co-kneader and a twin-screw kneader. Screw-to-barrel gap in the new twin-screw kneader is designed to ensure complete wiping and avoiding shearing inside the extruder as well as to offer the best feeding ability, greatest energy efficiency and the highest torque capabilities.



Screw-to-screw clearance at 0.25 mm



Single Flight 'V' Shaped Elements



award for their 'Co-Rotating Twin Screw Extruder, Omega 40 H Class', recently. Omega 40 H makes highly specialised, high-performance and cost-effective plastics with great ease.The award really affirms STEER's achievements & leadership in twin-screw technology with 'generation-next' extruders. Omega H Class has the ability to run difficult applications such as thermoplastic elastomers & vulcanites, wood polymer compounds (WPC) with polypropylene (PP), long fibre-reinforced thermoplastic (LFRTP). Further, at high temperatures, it can easily process shear-sensitive engineering plastics. The biggest advantage of OMEGA is the elongational mixing ability with its extra free volume. Another important feature of the OMEGA is the extent of control on the process in terms of specific energy input and most importantly the nature of work done on the material. It allows the extruder to operate in a wide process window, thus allowing success of difficult applications. All this was possible because of the 'steer way' of looking at changing needs of the users–the polymer industry customers. The challenges faced by the compounder had to be addressed with fast advanced dynamics of the market.

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>
> — **Dr. Babu Padmanabhan**
> Founder & MD, STEER Engineering

Given below is a description of traditional compounding equipment and the breakthrough designs introduced by STEER to gain major marketshare.

COMPOUNDING EQUIPMENT

Compounding is the process of converting raw polymer or base resin to a desired plastic form that is more effective, uniform and usable. In the last hundred years, three technologies have been developed to make a masterbatch or a compound–dispersive kneaders, co-kneaders and twin-screw kneaders.

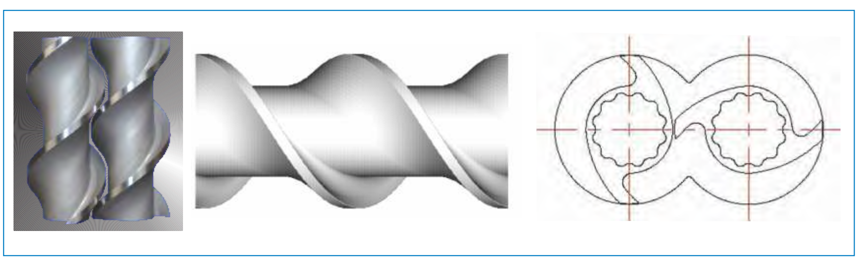
In a dispersive kneader, the material to be mixed is fed from the top into a mixing tank, which contains the mixer. These can handle low bulk material and high filler content.

Further, these kneaders are limited by the batch-type production, long residence time, high human intervention and process capability of limited resin types. Also, the system cannot handle highly adherent and temperature-sensitive resins, with large gaps between working members. It necessitates constant cleaning because some of the products may remain in the tank while mixing.

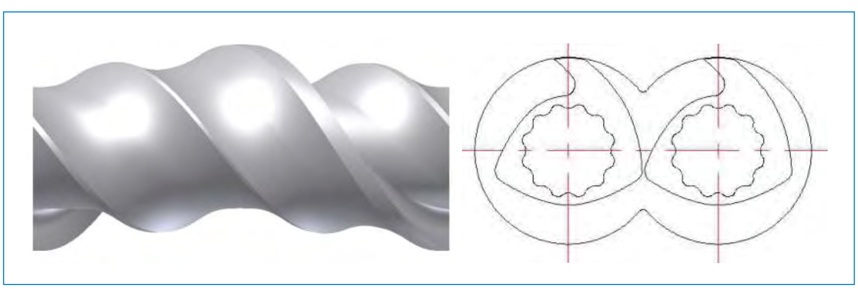
> By combining three kneaders, designing a screw-barrel gap to facilitate wiping instead of shearing, and by employing microgenic technology to increase wear resistance of extruder and materials used for machining extruders, STEER has improved the functionality of extruders used in polymer industry.

A co-kneader offers compression-free mixing, which avoids agglomeration, maximises stirring action and avoids or controls the shear peaks. It is exclusively a kneader and its functions such as metering, devolatisation, dispersion or controlled distribution of fibre need to be handled separately.

A co-rotating twin-screw extruder (TSE) was originally called twin-screw kneader because it was the only kneader that could

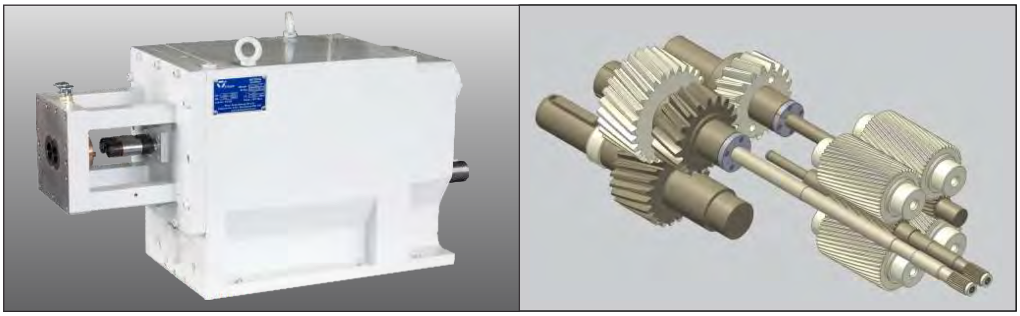


Regular Flight Shovel Elements



Triple Flight Shovel Elements

also extrude plastic strands directly. All these systems have undergone development and progress for over five decades. During this time, efforts have been made to gain control over the process. The progress over the first four generations of TSEs led to large-scale acceptance of the technology and its usage.



STEER Hitorq gearbox

BREAKTHROUGH ADVANCES

STEER has brought forth breakthrough advances that combine the advantage of the dispersive kneader, the co-kneader and the twin-screw kneader. The game-changing innovations that made this possible is detailed as follows:

Screw-to-screw gaps are similar to screw-to-barrel gaps

Screw-to-barrel gap is designed to create a wiping function rather than shearing. Therefore, in the new extruder, this gap is maintained at 0.15 or 0.25 mm to ensure that the extruder performs the wipe function and not the shear function. If the screw-to-screw gap is designed in a similar fashion, it will also wipe and not shear. STEER designs and manufactures elements that have screw-to-screw gaps similar to the screw-to-barrel gaps. This ensures complete wiping and avoids smearing or shearing inside the extruder. It also avoids meta-radial shear peaks and tail in residence time.

> The new developments by STEER decrease the wear in materials used for construction of extruders, by more than three times. STEER achieves this performance by employing microgenic technology that is derived from particle morphology in plastics.

High screw speeds, longer length/ diameter (L/D) (if necessary) and flexibility in screw design are possible. Design, manufacturing and metallurgical excellence in elements, shafts and gearboxes have led to addition of these features. More importantly, despite wear on the outer diameter of the element, the screw-to-screw gap remains the same.

Introduction of the special elements

SFV: Single Flight 'V' shaped (SFV) elements are based on a uni-lobe profile with a pushing flight machined at a negative angle, producing a concave form. The element profile has shown a significant increase (in some cases greater than 200 per cent improvement) in conveying efficiency for low bulk density and powder feedstock when used in the feed zone.

Before the advent of shovel elements, increase in screw speeds and feed rates was not linear–if the screw speed was doubled it did not result in doubling the feed but only flattened it out. This effect is prominent in the normal right-hand screw element (RSE) and the Schubkanten element (SKE). However, a shovel element not only allows for an increased output at the same rpm, but also linearly increases the capacity, with increase in the screw speeds. This allows the extruder to run at a higher rpm–300 or 600 rpm. The increase in feed rate is two-fold, but at 900 or 1,200 rpm the change in feed capacity is considerably greater. On a fluffy or aerated material, the effect is phenomenal.

RFV: Regular Flight Shovel (RFV) elements are based on a bi-lobe profile with a negative angle undercut pushing flight. The element offers enhanced intake and conveys efficiency in side-feed zones.

TFV: Triple Flight Shovel (TFV) elements are based on a tri-lobe profile using fractional lobe technology. The pushing flight also features a negative angle undercut. The TFV element can be effectively utilised for force-fed zones such as vertical densifier feeders and side feeders.

Fractional lobe technology allows screw elements to have different tip angles while maintaining the conjugal requirements of the twin-screw extruder design. Fractional lobe elements overcome the limitations of standard screw elements and provide greater flexibility in the design of individual elements, especially enhancing elongational mixing and allowing greater shear uniformity – key aspects to convert a screw device into a mixing vessel.

Hitorq gearbox: STEER gearboxes have minimal axial play, minimum backlash and equal angular deflection for both output shafts. This gearbox design has facilitated tighter clearances in the extruder.

Metallurgy

The new developments by STEER decreases the wear in materials used for construction of extruders, by more than three times. STEER achieves this performance by employing microgenic technology that is derived from particle morphology in plastics. The carbide particles, approximately 10 micron in size, which are generated due to the employment of this technology provide wear resistance to the extruder.

Acrolloy 10–A remarkable tool steel

Another significant achievement in the area of metallurgy is Acrolloy 10. Employing microgenic technology, STEER manufactured Acrolloy 10, which is composed of vanadium-rich tool steel along with other alloying and micro-alloying elements. In this tool, uniformly distributed interstitial and intra-granular micro carbides in the steel matrix result in wear properties that exceed the performance of hot iso-static pressed (HIPPED) powder metallurgy steels.

STEERING INNOVATIONS

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Courtesy: STEER Engineering