

## The Planetary Roller Extruder – a Universal Genius

*At the beginning plastics have been compounded exclusively discontinuously. This happened for example in heating/cooling blending combinations. However, by this discontinuous compounding the material was subject to constant fluctuations in quality caused by the indifferent dwell times. Therefore, at the beginning of the Sixties, there was a trend towards continuous compounding processes, in which, e.g. co-kneaders, twin-screw- and planetary roller extruders were used.*

More than 60 years ago, Mr. Wittrock of Messrs. Chemische Werke Hüls AG, nowadays Evonik, has invented the planetary roller extruder which found initially application in the PVC-calender industry. Since the Eighties ENTEX have consequently developed and perfected this process. By initiation of the heat transfer by means of pressurized water and an ameliorated construction of the cooling channels enabling a product-close temperature guidance and therefore having decisively influenced the heat transfer, this system has also been accepted more and more in other fields of application.

Today, the planetary roller extruder is no longer only the classic compounding aggregate for the PVC industry, but covers the whole bandwidth of the compounding and reaction technology. The planetary roller extruder is used in the

**Plastic Industry** – e.g., all kinds of PVC formulations, ABS, TPO, TPU, filled polyolefins, Prepreg, processing of caoutchouc, elastomer adhesives, etc.,

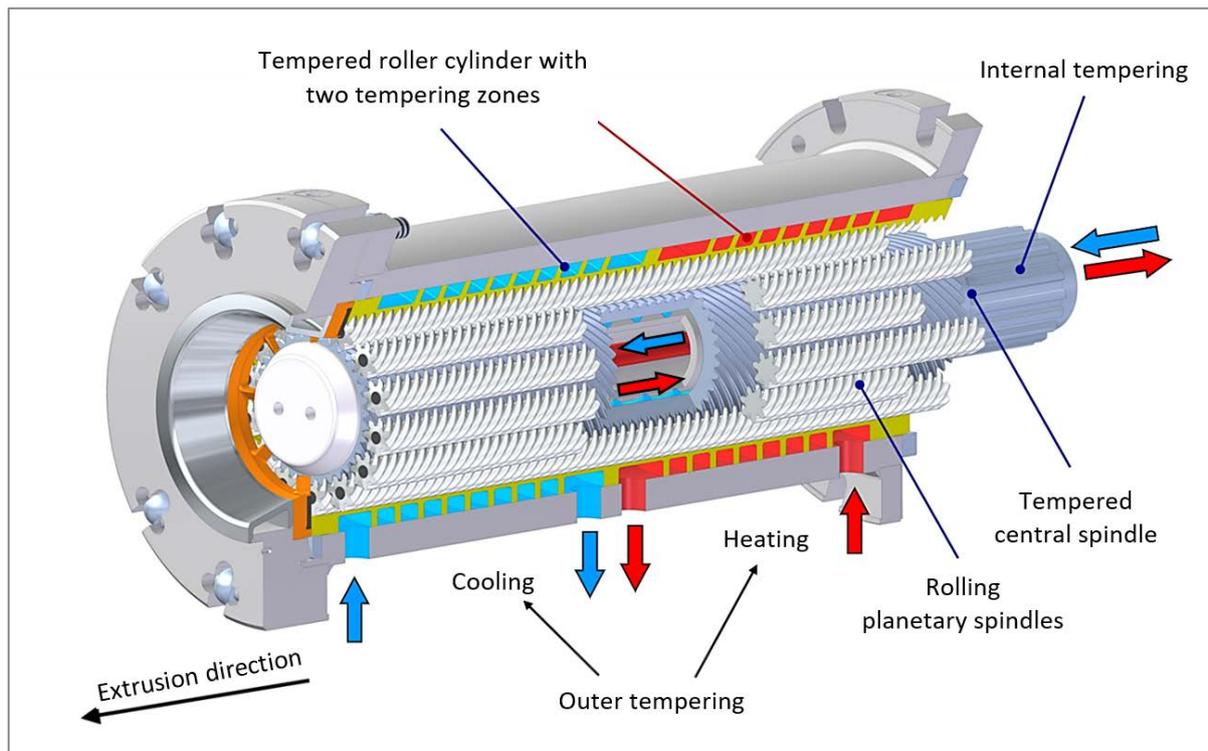
**Colour Industry** – e.g., epoxy-, polyester-, acrylic and similar lacquers,

**Chemical Industry** – e.g., blends with endothermic and exothermic reactions

**Food Industry** – e.g., cocoa – sugar – dispersion, special malts

**Pharmaceutical Industry** - e.g., pelletizing of hydrophobic and lipophile active ingredients

**Special applications** – e.g., sludge compounding, WPC Wood Plastic Composite



**Picture 1:** Sectional drawing of an ENTEX-Processing Part

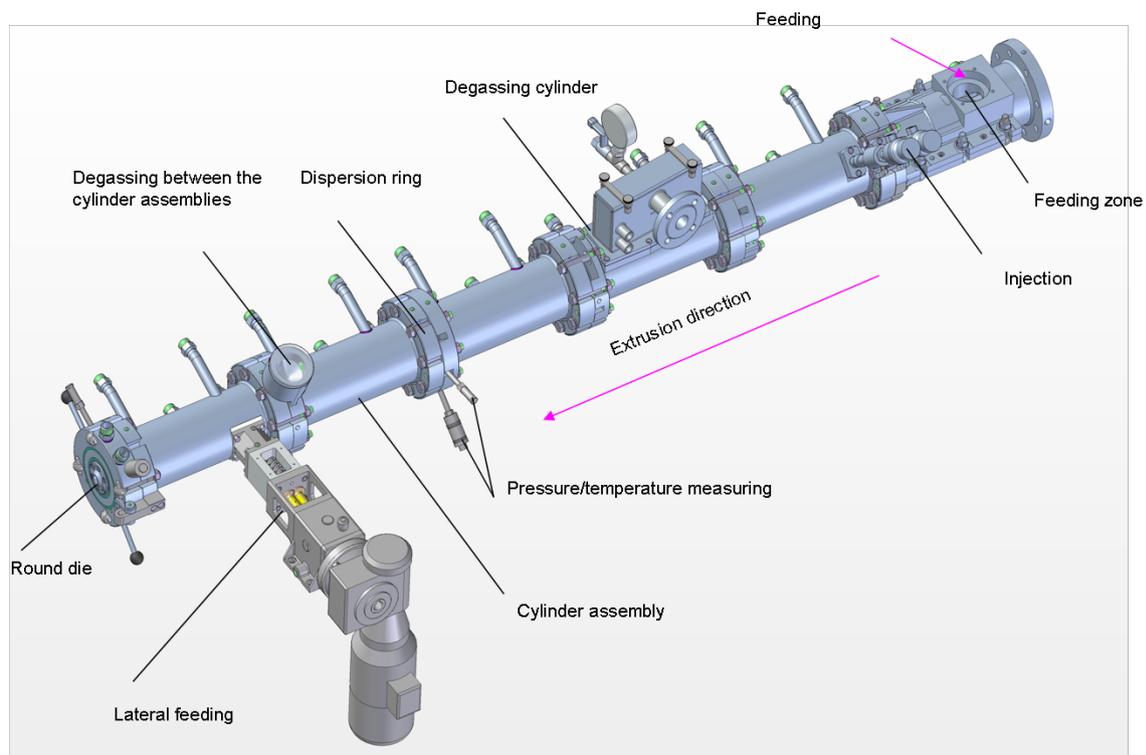
The principal item of the roller extruder is an ENTEX planetary gear with an extreme toothing width and a helix of 45°.

At the rotation of the central spindle the planetary spindles are rolling on the central spindle and the internally toothed cylinder assembly and rotate like planets. During this process the material will be caught and by the plunge of the spindle teeth into the corresponding tooth space the material will be drawn-out into thin layers and brought forward by means of the helix.

This repeated thin-layer rolling-out enables an exact temperature guidance during the whole compounding process.

The developments of ENTEX have optimized this system. Due to the production of the cylinder liner by means of the spark erosion process cylinder liners up to a length of 1.500 mm can be produced. This production process offers several advantages vice-versa the conventional production methods drawing, whirling or grinding. On the one hand the precise geometry of the involute tothing, even in hardened material, on the other hand a minimal wall thickness of the cylinder liner. Especially this minimizing of the wall thickness together with the repeated thin-layer rolling-out enable the most exact and gentle material compounding of all compounding extruders. Therefore, even material blends with high differences in viscosity can be processed without problems by means of this system.

To give you an impression of the contact surface area of a planetary roller extruder we will look at the standard size of an extruder for calender feeding. i.e., the TP-WE 250/2000-M2. On one rotation of the central spindle this planetary roller extruder contacts an area of more than 12 m<sup>2</sup>, i.e., at 50 rotations/min. an area of 600 m<sup>2</sup>. This corresponds to twice the size of a tennis court.



**Picture 2:** View of the modular system of the planetary roller extruder

A further development of the planetary roller extruder is the modular construction. In the modular construction several cylinder assemblies are connected which multiplies the processing range, up to 12 modules, e.g., at size 70. Due to this procedure the planetary roller extruder has passed the limits of conventional compounding extruders, e.g., single or twin-screw extruders, as the modern compounding technique develops more and more to process technology.

Therefore, also today the ENTEX planetary roller extruder presents a symbiosis of thermodynamic and strength shape. The extremely thin wall thicknesses, the possibility of pressure and temperature measuring, injection of viscous components and the degassing between the modules, allow compounding technology in new dimensions, unknown until now. Due to the variable arrangement of the planetary spindles and the use of blend and shear rings, dispersions are specifically controlled and are no longer left to chance.

The ENTEX radial pelletizing belongs to these innovations as well. During the development we used the specific advantages of the system of the planetary roller extruder which enable a direct pelletizing of the material in the hot die face cutting. Due to the minimum possible L/D-ratio materials can now be pelletized which could not be pelletized before. Dissipations of energy into the material, caused by hole plates, can be nearly excluded. Due to the radial arrangement of the borings, it is possible to place considerably more borings in the hole liner than in conventional hole plates. On this basis also the radial pelletizing with slot liner has been developed. Meanwhile this variation is successfully used for the calender feeding. The usual borings are replaced by slots. The outcoming material chips are, due to their shape, ideal for the calender feeding. Due to the excellent surface/volume ratio of the chips there is only a minimal cooling during the feeding process so that an optimal processing in the calender is guaranteed.



**Picture 3:** Planetary roller extruder TP-WE 250/1000-M1 for the plastic industry

As already mentioned, the future of the planetary roller extruder lies no longer only with the classic PCV compounding, but more and more with the chemical reaction technology, compounding of elastomer adhesives or compounding of Prepreg for the composite material industry.

The necessary extrusion units are no longer produced only in horizontal construction. ENTEX planetary roller extruders in vertical construction are in action today. Moreover, the use in the food industry is demanded more and more. Especially for bread, cake and pastries, dairy products, starch and sugar possibilities are unexpectedly opening-up.

Due to the newly developed formulations also the demand will increase for high performance compounding extruders like our planetary roller extruder. Therefore, we would like to convince you already now of the compounding variety of this ENTEX planetary roller extruder.

As an example, for a reactor for the chemical industry you will see below the planetary roller mixer C-WM 400/3000-M3 (picture 4), manufactured by ENTEX Rust & Mitschke GmbH.



**Picture 4:**

Chemical roller mixer  
C-WM 400/3000-M3

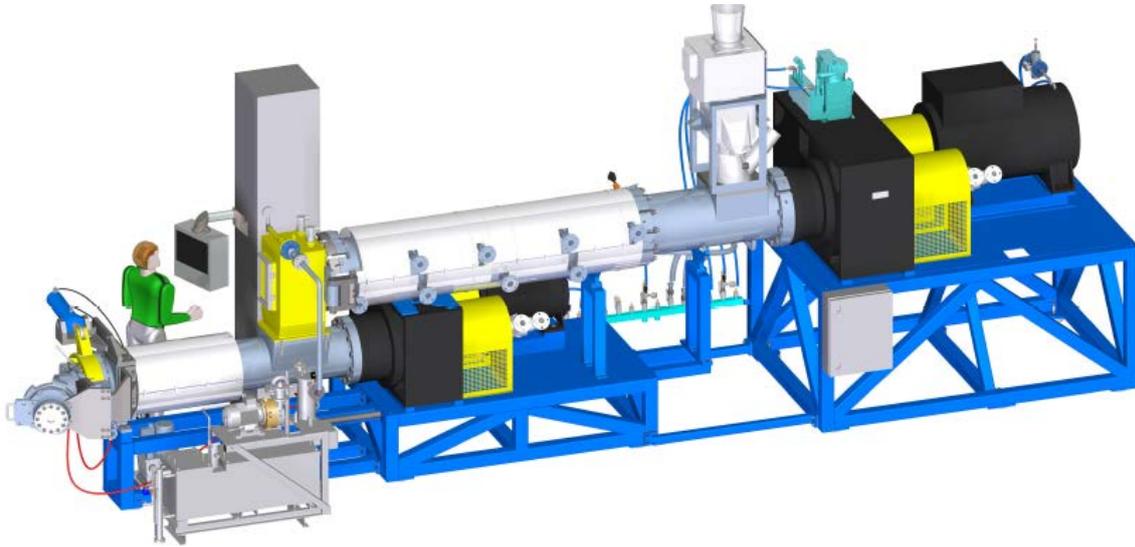
This roller mixer is optimal suitable for the mixing of viscous materials. Due to the precise temperature control, endothermic as well as exothermic reactions can be controlled in an optimal manner.

A further example (picture 5) for the strength of innovation was the commissioning of the world biggest Planetary Roller Extruder in the elastomer range in year 2010. This system with 4 modules and a drive capacity of 1.000 kW operates with an output capacity of approx. 6.000 kg/h.



**Picture 5:** TP-WE 400S/5600-M4 Planetary Roller Extruder for the manufacture of elastomers

Also a premium product (picture 6) is the world largest calender feeding plant with a power capacity of approx. 1.300 KW, as well as an output capacity of approx. 12.000 kg/h PVC-U with filler. The commissioning was in year 2011.



**Picture 6:** ZSTP-WE 400 S/2800-M2 / ESE 350 for PVC manufacture



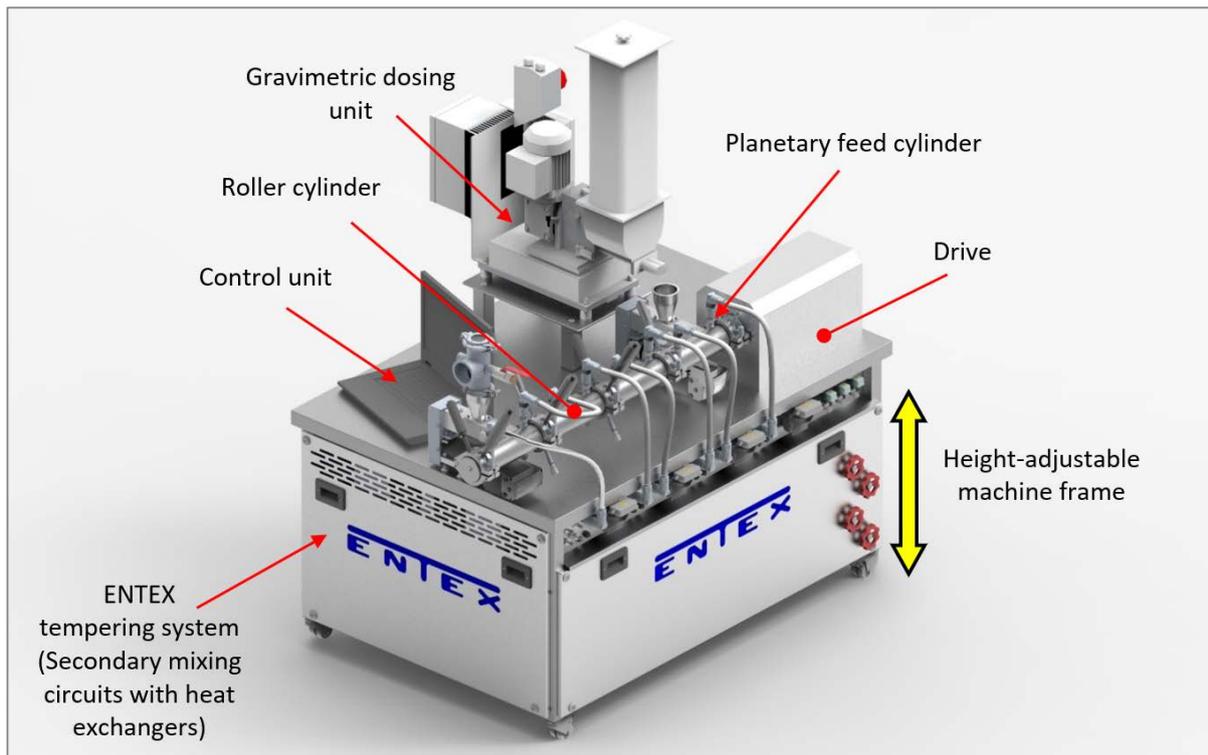
**Picture 7 a-b:**  
Planetary roller extruder for compounding of sewage sludge



**Picture 8:**  
Planetary roller extruder for food industry

The R-WM 650/800-M2 (picture 7) is the worldwide biggest, ever produced planetary roller extruder/mixer serving for the compounding of catch pit sludge for thermal disposal. The FI-WE 70/1200-M3 with side feeder (picture 8) is adequate for processes in the pharmaceutical industry and the food industry.

The modular extruder system of ENTEX has been completed with the Laboratory Extruder of size 30.



**Picture 9:** L-WE 30 Laboratory roller extruder

From Laboratory to practice - The Erlenmeyer flask of the 21st century.

This new development (picture 9) is a further addition to the ENTEX modular system, applicable e. g. in the plastic-, chemical-, food-, pharmaceutical- and cosmetic industries. With the L-WE 30, the advantages of the planetary roller extruder absolute temperature control, active ingredient-compatible mixing, low-shear thin-film rolling and large surface exchange can now be applied even in material critical areas. With this new laboratory extruder size, material quantities of "only" a few hundred grams per hour can now be produced.

The ENTEX planetary roller extruder combines economy and ecology and is therefore the most energy efficient modular system for the future of process engineering



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