

Range of applications **Chemicals**



THE CHALLENGE.

When it comes to successfully performing chemical extrusion processes with the Planetary Roller Extruder (PRE), there are several

decisive factors: rapidly mixing the reactants, targeted and precise temperature control, and high-performance devolatilization/ degassing.

THE SOLUTION: the ENTEX Planetary Roller Extruder.

Why is the ENTEX Planetary Roller Extruder the right choice for use with chemical processes?

Thanks to the Planetary Roller Extruder's multi-modular structure and process zones that can be regulated both thermally and mechanically, each process section can be individually configured for the reaction sequences in chemical processes. Be it mixing processes with endothermic and exothermic reactions or chemically

induced foaming processes, the degassing of chemical reactions or chemical recycling processes – the PRE's unique properties allow a wide range of technical process options for implementing chemical reactions in continuous extrusion processes.



Typical areas of application

- Polymerisation
(e.g. polyaddition, polycondensation)
- Cross-linking
(e.g. vulcanisation) of rubber products
- Branching
(e.g. silanisation)
- Devulcanisation
(e.g. recycling rubber products)
- Depolymerisation
(e.g. recycling plastics)
- Solvolysis
(e.g. hydrolysis)

**CHEMICALS****Benefits of carrying out reactive extrusion.****Rapid mixing of reactants**

As material is fed into the process, the tempered toothing (with large energy-exchange surface areas) repeatedly rolls it out in thin layers in the process section of the Planetary Roller Extruder. This ensures the rapid and homogeneous mixing and mastication of all substances and reactants,

allowing chemical reactions to be carried out quickly and effectively. Due to this, the amount of reactants can be reduced and/or the use of catalysts can be reduced or even completely avoided.

The modular design of the ENTEX Planetary Roller Extruder unique

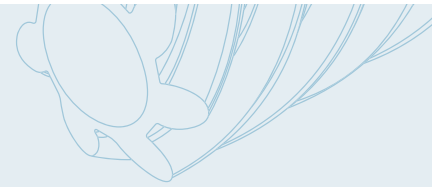
By configuring the process section for the specific process, it is possible to control the duration of reactions. By adapting the number of different process zones – configured as desired with a single roller cylinder or couplings of multiple roller cylinders – and the inner diameters of the dispersion rings installed between the process zones, different process steps (mixing, reacting, degassing, cooling, etc.) can be separated from one another and the extrudate dwell time in the individual zones can be regulated. Chemical reactants and other substances can also be added at different points – and in

different forms (solid material, liquid, gas) – along the process line.

By varying the quantity, length and type of the planetary spindles used in each individual process zone, processes can also be regulated with regard to their rolling, material transport, free volumes, fill level, pressure build-up, etc.

Our testing centers in Bochum and Shanghai allow us to address your individual needs and collaborate to create intelligent solutions for your requirements.

**HIGH THROUGHPUT****IMPROVED PRODUCT QUALITY**



Targeted and precise temperature control **the key**

Full-surface fluid-based tempering of the PRE process section enables the creation of precisely regulated temperature-controlled zones – allowing chemical processes in particular to be regulated more easily than would be possible with electrically heated systems. For example, the reactants can be mixed at a temperature that is lower than the reaction temperature, so that the reaction is only initiated in the subsequent temperature-controlled zone. A chemical

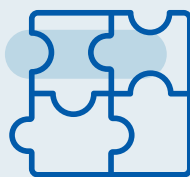
reaction can be extended across multiple process zones and terminated when desired.

The heat energy required for endothermic reactions can be added quickly over a short distance. It is even possible to effectively remove the heat energy that is generated by exothermic reactions should this be required.

High-performance devolatilization/degassing

Unwanted substances such as gases, vapours, alcohol, volatile decomposition products, etc. that are generated during the reaction in the compounding process can be passively evacuated at various points during the process using atmospheric deaeration, or actively evacuated by applying a vacuum. Residual monomers and reactants or solvents can also be removed in this way.

The utilisation of suitable vacuum pumps makes it possible to achieve degassing results of <1,000 ppm in a vacuum of <1 mbar. Effective degassing generally has a positive impact on product properties while decisively improving product quality.



SIMPLIFIED PROCESS CHANGES



A SECURE INVESTMENT

Precision extrusion A system concept that delivers.

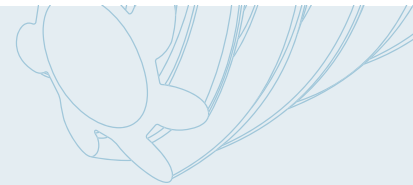
This system's combination of a targeted, process-oriented feed of various fluids and solid materials in defined process zones with mechanical configurability and efficient tempering allows it to conduct

gentle, low-shear compounding to produce extrudates with outstanding homogeneity. Every single step in the process can be controlled individually.

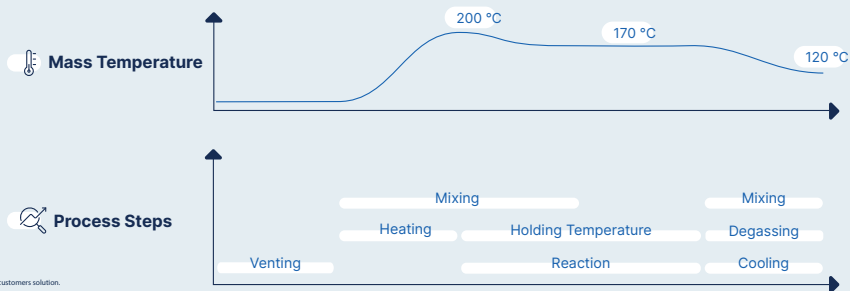
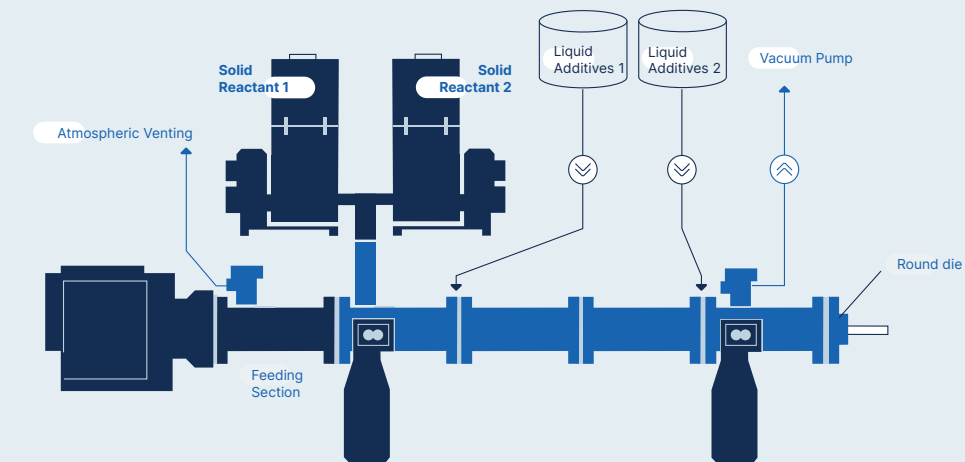


PRE-M4

The reactive extrusion process.



PRE-M4
Reactive Extrusion



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ENTEX Rust & Mitschke GmbH
Heinrichstraße 67 a | 44805 Bochum | Germany
info@entex.de | www.entex.de/en

Phone +49 (0) 234 891 22 0
Fax +49 (0) 234 891 22 99