

RAM- vs. Screw Extrusion?

Advantages of the discrete, discontinuous RAM extrusion compared to the conventional screw extrusion in the clean room production.

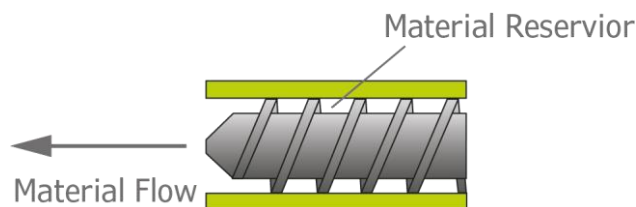
Both plastics and pharmaceutical agents are becoming more and more expensive, especially in the medical industry. For this reason, it is important to use as little material as possible in research and development, as well as in the manufacture of biodegradable implants, in view of saving cost. In this point of view, the RAM extrusion is an optimal alternative to the conventional screw extrusion.

Screw Extruder

In the production of implants with a screw extruder, the carrier material and drug are mixed and melted by the screw, at a defined temperature. After this, the homogenized mixture is extruded through a die. After hardening of the material there is a dispersion.

This method has the advantage that a continuous production of implants is possible, and the mixture of the individual material components is done in the cylinder of the extruder. However, this method also has some disadvantages.

- Shear heating in batch mode
- High material losses during cleaning and product changes (residual material in the cylinder)
- Complicated cleaning (attachments and screw must be separated from the cylinder)

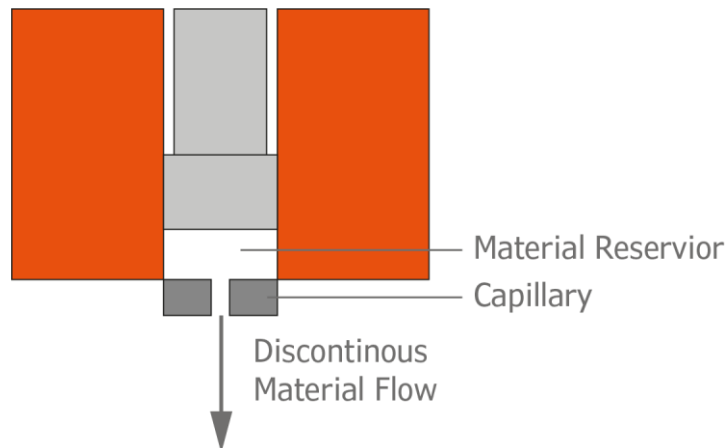


RAM extrusion as the perfect alternative

In contrast to the conventional screw extrusion, in the RAM extrusion, the mixed mass (drug and a pharmaceutical carrier material) is filled in a cylindrical barrel. The mixture will be compressed by the piston and then uniformly heated and melted. This method ensures a homogeneous and bubble-free compaction.

After a certain residence time the material is extruded from the barrel at a constant ram velocity (constant volume of material). In the zero position of the piston, there is only a small gap left between the piston and the die (position $h = 0$), which means that there are almost no material losses and thus a high cost savings by itself.

A die swell measurement can also monitor the strand size and an optional cutter ensures a uniform and reproducible length of the extrudate.



Advantages of discontinuous RAM extrusion

- Processing of very small quantities of material (important with rising commodity prices)
- Highly accurate volume output by pistons - barrel - capillary system
- Nearly residue-free use of the material used (punch position $P = 0$)
- Limited shear heating
- Easy cleaning (removal of the barrel)
- Easy documentation and tracking of individual batches
- Simple combination with die swell measurement and cutting device
- RABS or isolators formation are not a problem
- Material Reservoir
- Material flow

RAM Extruder von GÖTTFERT

For the RAM extrusion GÖTTFERT offers the best possibilities. Based on a capillary rheometer, the RHEOGRAPH 25E is used in research and development and in production under clean room conditions. The RG 25E works in a power range of up to 25 kN and a piston speed of 0.00005 - 40 mm / sec. The measurement and production processes can be defined by SCRIPT control of the software.



Figure: RHEOGRAPH 25E

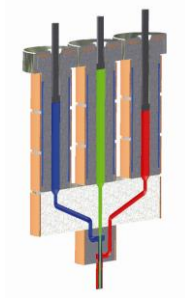


Figure: Scheme of the three-component batch process with the TRICO-Ram

With the TRICO-Ram, a three-component batch extrusion process can be performed. Here an extrudate which consists of 3 layers can be produced. The extrusion process is monitored and controlled by three pressure transducers, three product temperature sensors and a triple piston force control up to 40 kN.

Further advantages of RG 25E and TRICO-Ram

- A high-precision temperature control guarantees stable conditions in the reservoir
- Gentle heating process in the reservoir (as opposed to an undefined mixture in a continuous extruder, which can lead to undesirable shear heating)
- Constant and stable diameter of the extrudate by linearly driven ram (can not be achieved with pulsating flow of a screw extruder)
- High-priced products can be processed with a volume less than 100 ml per extrusion cycle

RHEOGRAPH 25E

GÖTTFERT RHEOGRAPH 25E is an innovative high-pressure capillary rheometer for determining the flow behavior and viscosity of thermoplastics and rubbers as well as for manufacturing implants in the pharmaceutical industry.



Figure: RG 25E

Technical highlights

- Constant high piston force of 25 kN
- Dynamic speed range: 1:800000
- High dynamic piston acceleration 0-40 mm/s in 0.6 s
- Position acquisition: high resolution encoder (0.0000016 mm)

Further highlights of RHEOGRAPH 25E

- Stainless steel design for operation in clean rooms class A
- Compact and service friendly design with easily accessible components
- Temperature control algorithm, resolution 30 to 250 °C: 0.01 °C
- 5 temperature calibration data sets each with separate control parameters for optimal adaptation over the full temperature range
- Integrated timer for automatic heat up
- Electrically heated test chamber with easy exchangeable test barrel
- Test data recording with force transducer
- Operation modes constant speed or constant force
- Determination of the apparent or true shear stress by measuring the test punch force
- Infinitely variable manual piston drive control

TRICO-Ram

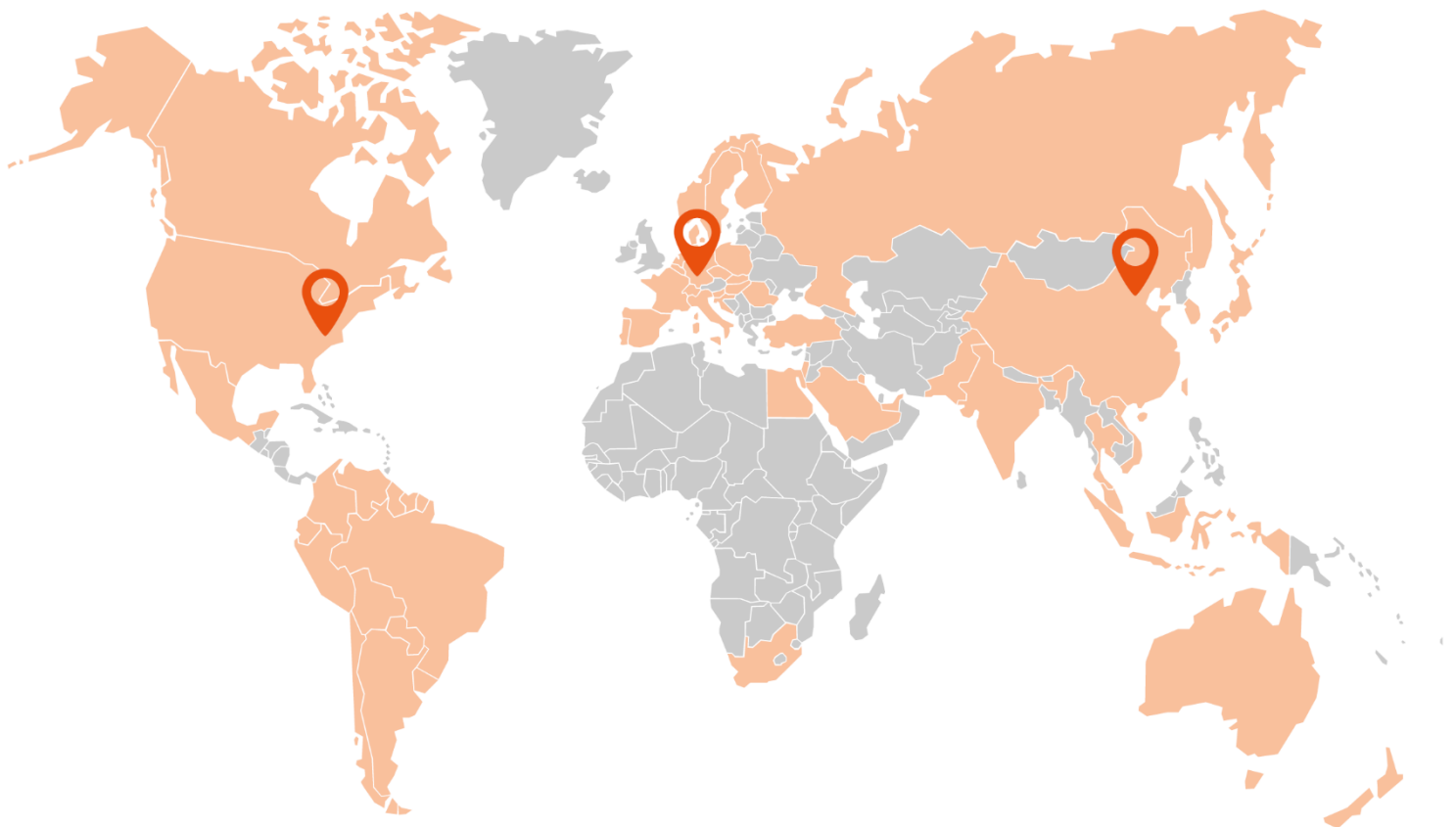
Three-component batch extrusion process



Figure: TRICO-Ram

- Temperature control from +30 °C to +250 °C
- The extrusion process is monitored and controlled by three pressure transducers, three product temperature probes and a triple punch force control up to 40 kN
- Suitable for cleanroom class A conditions
- Script controlled via GÖTTFERT LabRheo
- Three independent, speed-controlled pistons extrude products in a speed range of 0.00005 to 40 mm/s
- A reservoir of 200 ml is available in each of the three flow barrels
- Due to the independent piston speed control, different volume flows can be processed in all three barrels

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