

Revolutionary increase in the productivity of elastomeric profiles: HENSCHEL Xtreamor® sets new quality and throughput standards

The Xtreamor® melt pump developed by HENSCHEL is for the first time used in the production of elastomeric profiles, with the result, that the output of the extrusion line is increased fourfold

The Xtreamor® melt pump was developed by HENSCHEL with the aim of creating an efficient pressure build-up system as an alternative to conventional melt pumps in the field of polymer processing. At this stage, no one at HENSCHEL thought of elastomer processing.

An end-user from the elastomer manufacturing and processing industry, who saw the Xtreamor® at the NPE 2015 in Orlando, had the presumption, that he could push his elastomer extrusion processes with the Xtreamor® into new dimensions. Therefore he sent appropriate materials in a prepared strip shape to Germany for extrusion tests in HENSCHEL ExtruTec's newly built technical centre. These tests showed the advantages of a well-equipped laboratory for material and throughput research. The extremely positive laboratory results led to the order of an Xtreamor® with HENSCHEL'S control, which is fed by an existing elastomer single-screw extruder at the customer's location.

Twin-Screw Melt Pump Xtreamor® HMP 2-60



The new customer of HENSCHEL ExtruTec GmbH was right with his assumption: Already during the first tests at the customers plant with the Xtreamor® it was possible to increase the extrusion speed from 200 m/h to 780 m/h. At the same time, the conditioning of the elastomer melt was significantly improved, so that the extruded profiles have so far shown unique excellence in the surface quality, and the dimensional stability met the highest requirements. This new quality also led to a production ability of batch sizes of 30 km without extrusion interruptions. The customers statement was that this uninterrupted

and high-quality production in the mentioned form had not been possible so far.

The Xtreamor® has now been in use for 3 months by this customer, and he has explored the new possibilities for completely different extrusion profiles, while continually attesting to this machine to be "extraordinary".



The following photographs show the double-strand extrusion of two elastomeric profiles for special seals. The soak process after the nozzle is clearly visible. The construction of the impact plate tools for these extrusion profiles shows a large window of acceptable processing bandwidths even at high speed differences. This allows the advantage of the



choice of a free extrusion speed to be utilised, which is possible with the aid of the **Xtreamor®**. The **Xtreamor®** can fully extend its special strength in the elastomer area! Thus, the new customer of HENSCHEL ExtruTec GmbH had made a proper decision with the purchase of an **Xtreamor®**.



The service department of HENSCHEL ExtruTec GmbH had the opportunity to accompany the production in the factory of the customer for several days.

When the analog control of the "old" elastomer single-screw extruder was integrated into the HENSCHEL control, nonlinearities of the characteristics of the speedometer machine and the analog rotational

speed setpoint interface in a first phase showed to be present, which in turn led to impractical discrepancies in the visualization of setpoint and actual speed.

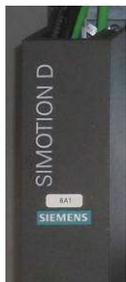


In order to solve this problem without incurring a considerable amount of adjustment, as well as to obtain an absolute speed accuracy (which is indispensable for the application of recipes), on the motor shaft it was interlaced in parallel to the analog speedometer machine (which is rooted in the old direct-current-machine inverter) a HENSCHEL retrofit module with a digital encoder inside (lacquered in green as the **Xtreamor®**).



Its encoder signals are converted via an interface (see photo on the left) to the Siemens DRIVE-CLiQ® protocol and thus directly connected to the SIMOTION® D control unit, which is recognizable in the middle and right-hand

picture, in which a digital correction speed controller is implemented, being superimposed to the old analog inverter control.



Thanks to the state-of-the-art control of the **Xtreamor®**, in this way a very elegant integration solution could be realized with this customer.

Back to elastomer extrusion:

The following figure shows a profile produced with the **Xtreamor**[®], which is relatively wide compared to its thickness. Differences in thickness are basically difficult to extrude. The design of the tools is here the limiting parameter for speeds. If these profiles run on different lines with different capacities, thus different tools are used for the production.

Thanks to its principle of forced material throughput, the **Xtreamor**[®] has the possibility to adjust a throughput precisely and reproducibly. By designing the corresponding screw geometries, a very uniform discharge constancy is achieved which does not result in any pulsation effects or thickness differences in the longitudinal direction. Also with these profiles the customer is convinced by the product quality and surface excellence achieved with the **Xtreamor**[®].



At the other end of the production spectrum we are dealing with large-cross-sectional profiles, which may at the same time consist of particularly heavy formulations. The illustrated example comes from a sampling test production on a request for an application as a rubber armor protection in the Panama Canal. The profile has a mass of 6 kg/m.



According to our customer, he was able to realize this type of production exclusively with the **Xtreamor**[®]. The performance of the elastomer single-screw extruder was increased several times by the **Xtreamor**[®], so that the production of very lightly profiles with good homogenisation and a corresponding property profile could also be ensured. So far the performance limits of the **Xtreamor**[®] have not yet been reached; in this area the potentials for the output and the application of various types and formulations of elastomers have hitherto been exhausted only to a small extent.

For standard elastomer lines, where the limiting factor is often the performance of the microwave vulcanizing furnace, the **Xtreamor**[®] HMP 2-60 is generally sufficient for both light and heavy profiles. The



The next-size **Xtreamor**[®] models HMP 2-100 and HMP 2-140 for correspondingly high throughput ranges – up to several tonnes per hour – will be used in the production of elastomer profiles only for large profile cross-sections or special lines. From today's perspective, we estimate that the **Xtreamor**[®] Melt Pump HMP 2-60 can cover most of the elastomeric profile production. Important questions here are the use of different natural and synthetic rubber types and the use of the **Xtreamor**[®] in combination with a wide variety of plasticizing aggregates. It may well be that a pin extruder for producing profiles can be optimized for the output same as e.g. a variant of a kneading machine. Here, a significant advantage of the **Xtreamor**[®] is that feeding with pre-pressure is possible, same as a pressureless feeding, especially for kneaders, is used. This is due to the fact that the **Xtreamor**[®] can be designed both in the layout with two screws lying on top of the other as well as with screws lying side-by-side.

A very significant advantage compared to the conventional melt pump is the use of a wide variety of screw geometries for various types and formulations of elastomers in an **Xtreamor**[®]. A limiting factor for an existing screw geometry is a circumferential speed of the screws typical for elastomers. Circumferentially, the maximum shear load on the elastomer is generated, thus also the maximum temperature development. In order to avoid damage or local cross linking, the circumferential speed is the limiting factor.

If high demands are placed on temperature constancy or the cooling-down of a polymer melt, the screw set of the **Xtreamor**[®] is equipped with an active internal cooling system. A very important advantage of the counter-rotating twin-screw, which is used here, is also that the screws are largely self-cleaning. When requesting extreme surface-adhesive formulations, special screw coatings are used.

The picture shows three examples of different screw sets for the **Xtreamor**[®] HMP 2-60, which have been used in previous tests with elastomers and polymers. However, the use in this area is only one field of application for the **Xtreamor**[®]. The **Xtreamor**[®] has been developed as an alternative to the gear-type melt pump and is essentially used where conventional melt pumps reach their limits. The **Xtreamor**[®] is a pressure build-up element for all areas of the processing of thermoplastics, elastomers or other substances to be processed plastically. This also applies to the processing of food in the pet and human area.



Conventional melt pumps have disadvantages, the most important of which are:

- A minimum pressure is required for loading.
- Conventional melt pumps have deficits in the set-up of a constant mass throughput and can thus impair product quality.
- The lubrication of the conventional melt pump happens by the polymer-melt. Depending on the filler materials used, this can lead to very rapid wear of the bearings, which is extremely cost-intensive.
- The use of shear- and temperature-sensitive substances is not possible or is only possible to a limited extent, since each gear-type melt pump has a back flow with locally high shearing in the region of the lateral walls and at the tips of the teeth and thus has a longer residence time spectrum with locally strongly shear-impacted melt.
- Gear-type melt pumps produce a friction which can only be compensated for inadequately and within the limits of possible temperature control systems.

The **Xtreamor**[®] developed by HENSCHEL ExtruTec GmbH does not have the above-mentioned drawbacks. On the contrary – there are additionally a multitude of possibilities, which are only available in the **Xtreamor**[®] by HENSCHEL. Overall, the following advantages of the **Xtreamor**[®] are:

- Supply with lowest pre-pressure (also possible gravimetrically in free fall)
- Relief of the compounding plant or the extruder from the pressure build-up
- Continuously gentle pressure build-up up to highest output pressures (standard up to 350 bar, optional up to 500 bar)
- Constant or controllable melt temperature
- Melt cooling in the **Xtreamor**[®]
- Adaptation to the throughput medium by various screw geometries
- Use also with extremely high or low viscosity materials
- Increasing the output of compounding or extrusion processes
- Very high constancy of extrudate quality
- Lowest material stress



- Approximately pulsation-free material transport
- Ideal throughput of highly filled formulations for pressure build-up
- Ideal throughput of shear and temperature-sensitive formulations for pressure build-up
- Very narrow residence time spectrum in the melt pump
- Significant energy savings in the overall process
- Negligible leakage flows in the melt pump
- Coverage of an extremely wide operating range due to the possibility of changing between different optimized screw sets
- Extremely easy to service due to fast screw exchange and easy cleaning of the screws
- Possibility of injection of gaseous or liquid additives such as foaming agents or other reactants
- Possibility of vacuum degassing via the "screw shaft"
- Supply depending on the process either on the side (vertical arrangement of the screws) or from above or from below (horizontal arrangement of the screws)
- Flexible integration into the plant: standard variant (90° to the line axis) or inline variant (by 15°–30° to the line axis)
- Higher service life of the upstream system since no pressure build-up is necessary
- Excellent use in the area of pet and human food
- Hitherto unprecedented possibilities in chemistry also in the case of adhesive and reactive materials
- Increase in production capacity on older plants by increasing the output speed
- Shortest ROI by significantly increasing the performance of existing plants

HENSCHEL has protected the system of the **Xtreamor®** by worldwide patent applications. Over the next few years, it will create new opportunities and have many possibilities for the extrusion of elastomers and thermoplastics, but also in the chemical and food sectors, and will help to operate plants more efficiently and to increase the output. In addition, various polymer processes, particularly in the area of reactive extrusion, will arise to become possible. Discontinuous processes in chemistry suddenly allow for a continuous flow. Even low-viscosity substances from the area of adhesives or high-temperature-resistant thermoplastics offer new processing possibilities.

Convince yourself and visit us at the K-fair 2016 in hall 9, booth C77.

Talk to us, we have an excellent technical centre. Use our development possibilities for your products.

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