

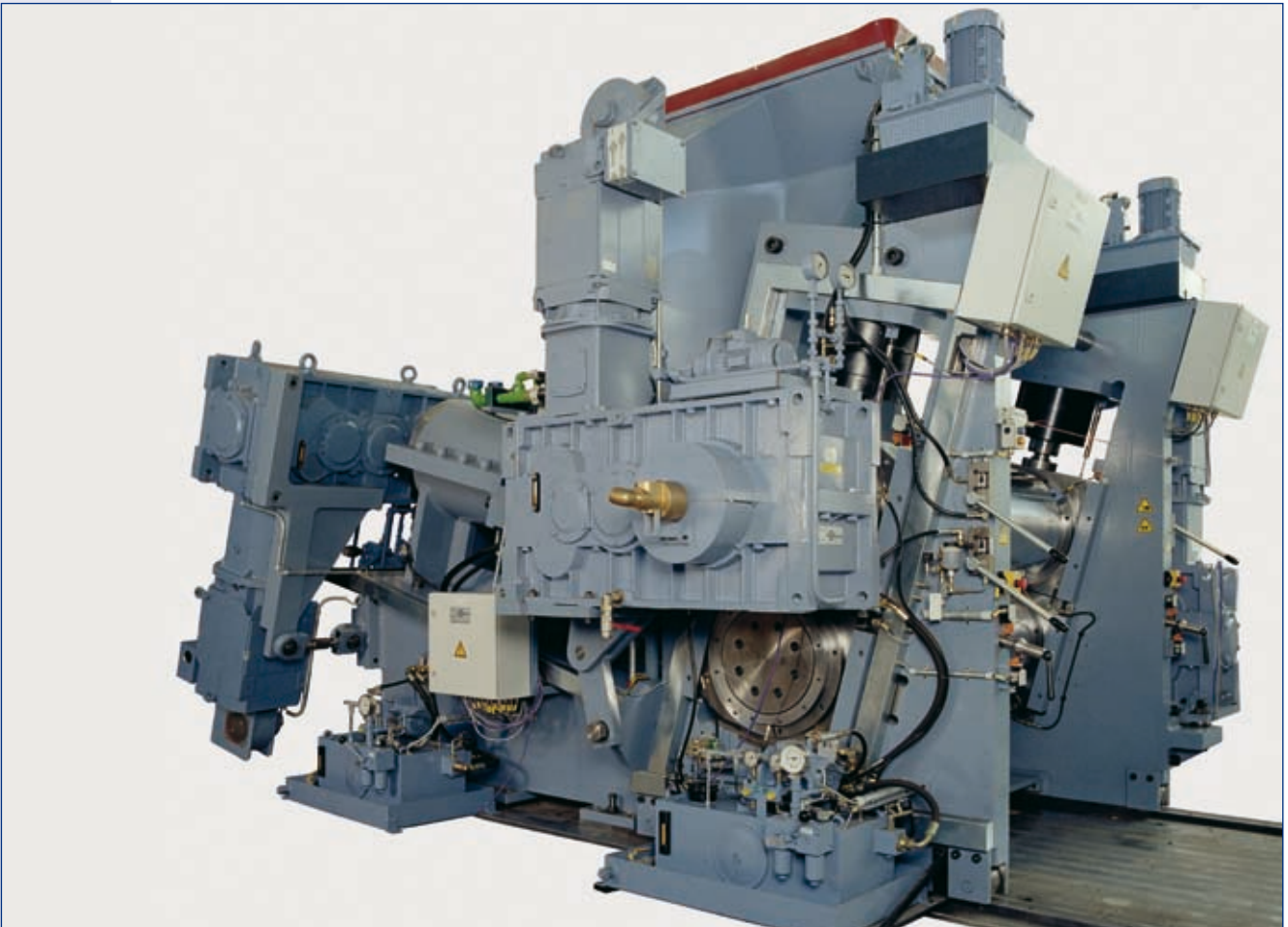
## Dump Extruders



## Dump Extruders

Harburg-Freudenberger dump extruders ensure the optimal technical and economic production of rubber and related compounds in a variety of different forms. They are available as EAE single-screw dump extruders with pelletizing, granulating or tube die heads, or with roller-die calenders, depending on their application.

The DSE conical twin-screw dump extruder is primarily used in the tire industry, normally with a roller-die calender. All the dump extruders and internal mixers manufactured by Harburg-Freudenberger are closely matched for size and throughput.



*Twin screw extruder DSE 450 with roller-die calender 610 x 1400*

### The rubber compounding technology division

In addition to dump extruders Harburg-Freudenberger supplies complete mixing room systems, from bulk storage silos, weighing and feeding equipment, to mixers, two roll mills and other peripheral equipment.

Twin-screw dump extruders (DSE) are now used increasingly to replace two roll dump mills for the production of rubber compound, especially in the tire industry, because they offer the following advantages:

- Mixing line automation
- Improved operational safety
- Improved compound quality/consistency.

The single-screw dump extruder offers similar advantages and is often used for compound straining applications, a practice that has long been established in the cable industry.

This trend is also taking place in the technical rubber goods industry. Global competition has resulted in intensified automation in compound production to reduce production costs.

The machine concept is also ideal for the production of thermoplastic elastomer based compounds.

Based on our many years of mixing experience, Harburg-Freudenberger offers a full range of dump extruders and two roll mills to provide the most suitable solution for a wide variety of applications.

### Twin-screw dump extruders (DSE)

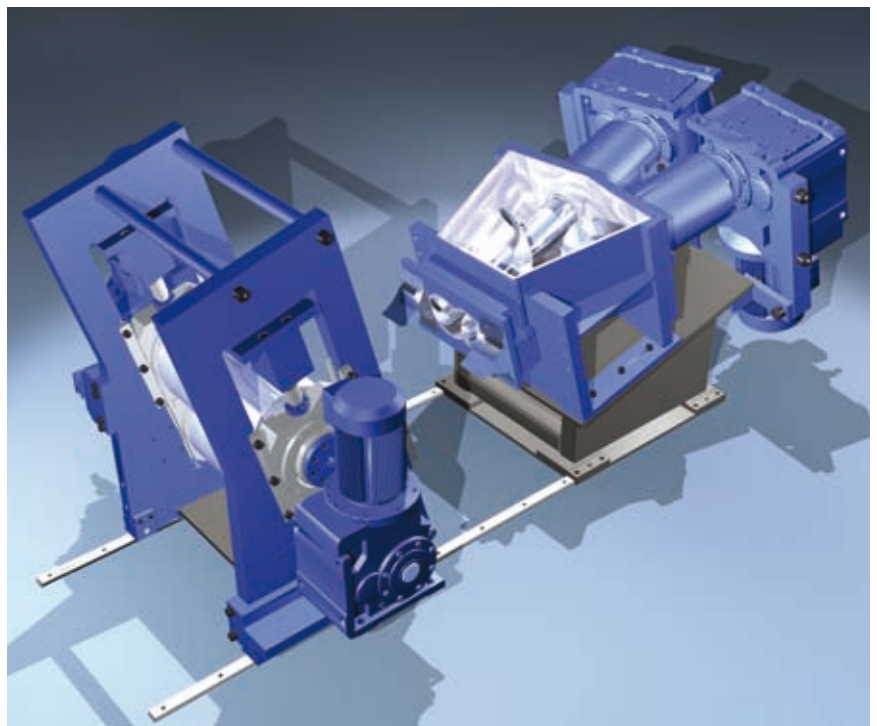
The principle parts of the conical twin-screw dump extruder are the open feed housing and the short, closed, pressure section. The feed housing determines the machine capacity and is adapted to the size of the drop door of the internal mixer above. The conical screws are located in the feed housing. Their wide screw flights draw the compound in and transport it into the pressure section of the extruder. In doing so the DSE creates a continuous process.

Roller-die calenders are available in various sizes to produce sheet in various widths and the actual sheet width is determined by material guides that protrude into the back of the roller die nip. Every part of the machine that comes into contact with the compound, such as the feed housing, screws, calender rolls and material guides are temperature controlled.

On compound change over the extruder is self-cleaning and carry-over is virtually eliminated. Minor compound residue in the pressure section can quickly be removed, as the front of the screws are readily accessible with the roller-die calender moved into its forward position (see fig.).

The DSE provides automation of the production process reducing personnel requirements and mixing costs.

As an alternative option compound straining can also be carried out in line with the DSE. In this case the roller-die calender is removed and the DSE combined with a gear pump to produce the high compound pressures necessary for straining.



Conical twin-screw dump extruder with roller-die calender

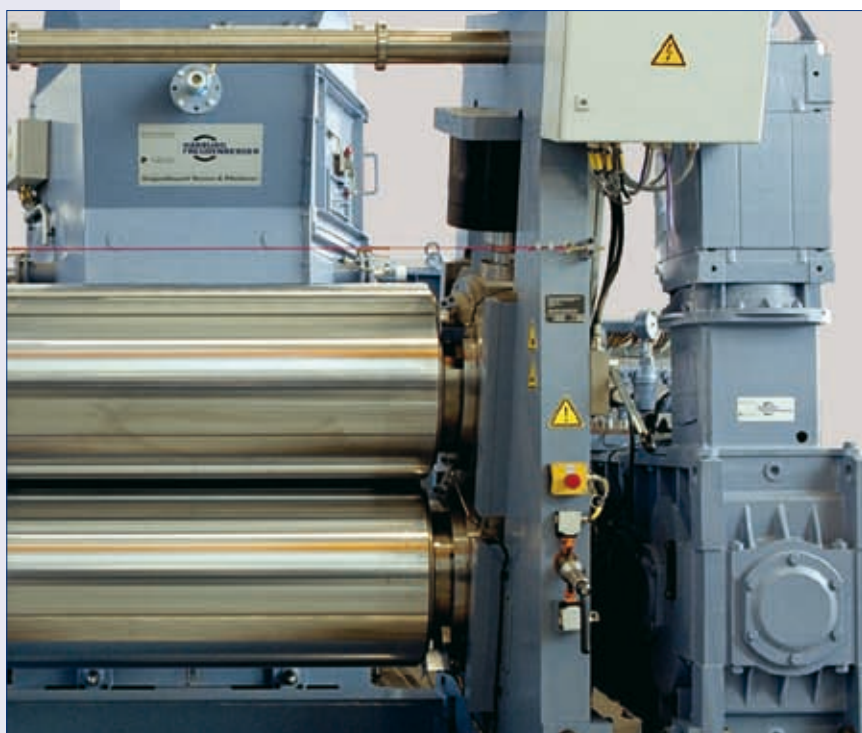
### **DSE 330: Flexible, economical and reliable**

The design of the roller-die calender on the DSE 330 is based on decades of experience of Harburg-Freudenberg in the construction of roller-die calenders and two roll mills. Individual drive solutions have now established themselves in this type of machine technology. The position of the rolls is hydraulically adjusted. Two connection concepts, between the extruder and the roller-die calender, ensure that the DSE 330 can be easily adapted to meet various requirements. The mechanical linkage between the extruder and roller-die calender takes up very little space. Cleaning and inspection can be quickly and easily completed as the rolls can be moved apart vertically. Alternatively, the roller-die calender can be moved forward so that the area between the extruder and the roller-die is easily accessible. In this configuration the overall height of the roller-die calender is also reduced.

The DSE 330 is equipped with an intelligent control system to make it the ideal machine for the production of sheets from rubber and other related compounds.

The control functions include:

- Adjusting the output rate between the extruder and the mixer
- Maintaining automatic operation in stop-go or continuous modes
- Producing sheets of consistently high quality



*Calender section*

Harburg-Freudenberger uses two different methods to synchronize the screw drives.

#### Synchronization by „electrical shaft“

A positional control system synchronizes the screw speeds. A virtual shaft, in the form of a positional signal, is supplied from a rotational speed set-point signal from the PLC. Position sensors in the AC drives signal the actual position of the screws, so that the current and speed of the motors can be adjusted accordingly by a frequency converter. A second circuit based on absolute value transmitters mounted on the screw shafts is also provided to protect against all possible faults. In the event of a fault such as power

failure, position sensor failure or cable breakage, the extruder screws are slowed down or stopped. The advantage of this drive concept is that it is wear free, as there is no mechanical coupling between the screw shafts. The compound intake behavior of the machine means that the loads on the individual screws are not constant and change depending on which screw flight is currently engaged. The system offers another significant advantage: That within predetermined limits, a small relative movement can be made between the screws to create a self-cleaning action with the screws „scraping“ the screw channels, this being especially useful in the technical rubber industry.

#### Synchronization by geared coupling

The screw drive operates on the master/slave principle, where the PLC supplies the desired speed for the master drive and the slave follows the master's lead. This geared coupling variant has a very robust design to safely absorb the load differences resulting from the extrusion process.

In addition to the electro-mechanical drive variant, Harburg-Freudenberger also offers a compact hydraulic drive solution where the pipework has been reduced to an absolute minimum.

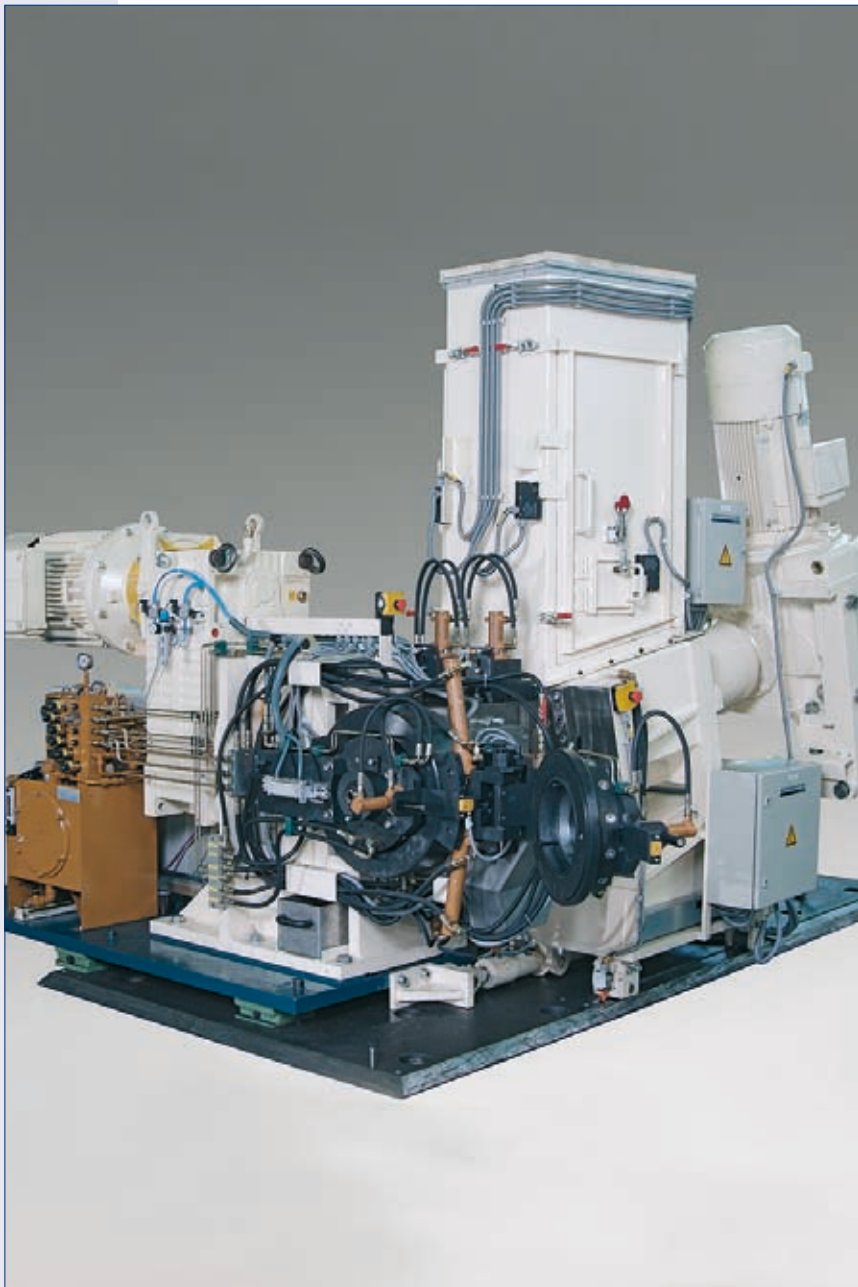
Irrespective of the drive variant, the machine is fully tested in operation with material at our works, so that installation/commissioning time at the customer's site can be minimized.

#### Technical data of the twin-screw extruder with roller-die

Extruder		DSE 200	DSE 280	DSE 330	DSE 450
Screw diameter	approx. mm	480/200	670/280	800/330	950/450
Screw length	approx. mm	820	1.170	1.400	1.550
Variable screw speed	min <sup>-1</sup>	2.5 – 25	2.5 – 25	2.5 – 25	2.5 – 25
Drive capacity	kW	2 x 30	2 x 60	2 x 95	2 x 150

Calender		DSE 200	DSE 280	DSE 330	DSE 450
Roll diameter	mm	360	500	500 – 610	610
Roll length	mm	650	1.050	1.050 – 1.400	1.400
Drive capacity	kW	2 x 30	2 x 74	2 x 74 (2 x 95)	2 x 95
Roll gap (adjustable)					
Working gap	mm	3 – 10	3 – 10	3 – 10	3 – 10
Maximum gap	mm	150	50/200	50/200	50/200
Sheet width (roll length) max.	mm	500	900	900 – 1.200	1.200
Variable roller speed	min <sup>-1</sup>	2.3 – 25	1.9 – 19	1.9 – 19	1.5 – 19
Forward movement	mm	1.500	1.500	1.500	1.500
Theoretical output rate	ca. kg/h	6.000	15.000	18.000	21.000



### DSE with gear pump

The automotive industry places very high demands on the surface finish of sealing profiles that are visible when fitted to a vehicle.

Today the compounds used for this purpose are often strained on separate lines to eliminate contamination that could result in surface defects. However this results in increased production time, higher labor costs and reduced efficiency.

An optimal solution can be achieved by combining the DSE with a gear pump, so that the higher compound pressures, required for the straining process, can be generated.

The adjoining illustration shows a typical machine. This is equipped with a twin head system for rapid strainer plate or die change. Dies can be letter-box, tube or other profiles as required.

*DSE 150 with a flange-mounted gear pump and twin head to strain rubber compounds.*

### Technical data of the twin-screw dump extruder with gear pump

Extruder		DSE 150	DSE 280	DSE 330
Screw diameter	approx. mm	480/150 – 200	670/150 – 280	800/330
Screw length	approx. mm	840	1.170	1.400
Variable screw speed	min <sup>-1</sup>	3 – 30	3 – 30	2.5 – 25
Drive capacity	kW	37	60	95

An important factor in the concept of inline straining is the effect on the compound temperature. From the energy balance of a stationary flow process it is possible to deduce that a pressure increase within the system is associated with a temperature increase within the compound, i.e. the internal energy of the compound increases.

Consequently considerable attention must be paid to pressure raisers when designing such installations. This applies particularly to the design of the strainers because the strainer packs form an invariable constant. The Harburg-Freudenberger design ensures the effective cooling of all the machine components that come into contact with the compound to minimize this effect.

### Producing thermoplastic elastomer compounds

The production of thermoplastic elastomer compounds in an internal mixer can be interesting in terms of compound quality and cost. This mixing technique however requires appropriate dump equipment to granulate the compound for further processing. A twin-screw dump extruder with a gear pump and a granulating unit ideally fulfill these requirements. High-melt polymers such as polyamide 6.6, require processing temperatures of up to 300°C (TPE-V). The internal mixer is equipped with a high-speed drive to achieve the high mixing tempera-

tures through the shear heat imparted by the rotors. In addition the DSE can be temperature controlled to prevent “freezing”. The illustration below shows a typical DSE combined with integrated gear pump.

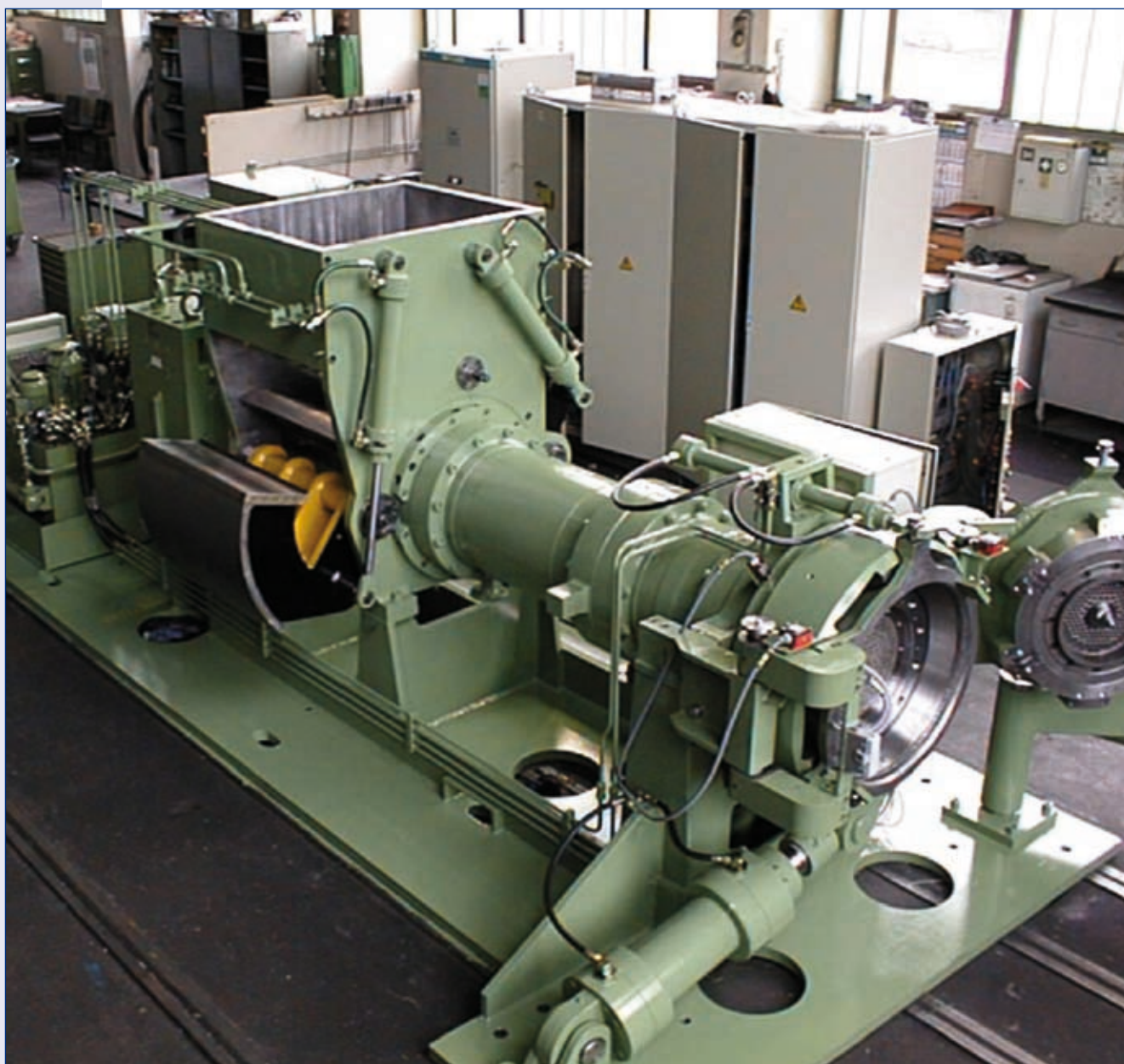
*DSE 280 can be temperature controlled and features a flange-mounted gear pump to process thermoplastic elastomers.*



### Single-screw dump extruder (EAE)

The automation of a mixing line or the requirement for in line straining are significant factors favoring the use of the EAE, because the single-screw dump extruder can easily generate the high compound pressures required for straining.

The single-screw dump extruder consists primarily of a feed housing with extruder cylinder and screw. The double-walled steel feed housing features spindle-shaped ducts for tempering. The extruder cylinder and screw are also equipped with effective cooling circuits. The intake of compound



Single-screw discharge extruder with roller-die calender and „Pork Chop“ facility



in a single-screw dump extruder is not automatic and the compound normally has to be pushed into the feed section of the screw by some external device. To make compound feeding as effective and robust as possible, Harburg-Freudenberger has developed a compact twin rotary pusher system to ensure

uniform feeding and minimize pressure fluctuations at the extruder head. The extruder screw design ensures minimum temperature/time build up in the compound. The entire EAE extruder head can be swiveled out and features an effective self-cleaning system.

Harburg-Freudenberger can provide roller-die calenders, granulating heads, tube die heads and other profiling and straining options. In the cable industry for example, the head normally incorporates a strainer plate that can house the strainer sieve package and the compound is extruded into strips of various profile, or granulated as required.

#### Single-screw dump extruder

#### EAE series with or without strainer, with or without tube die head or granulator

Type classification	EAE	200	250	300	400
Screw diameter	mm	200	250	300	400
Speed range	min <sup>-1</sup>	5 – 50	4 – 40	3.3 – 33	2.5 – 25
Rated capacity* (L:D=8,5:1)	kW	95	140	190	315
Output	kg/h	500 – 1.300	1.300 – 2.100	2.100 – 3.000	3.000 – 5.200

#### EAE series with roller-die calender or „Pork Chop“ head

Type classification	EAE	250	300	400	500
Screw diameter	mm	250	300	400	500
Speed range	min <sup>-1</sup>	4 – 40	3.3 – 33	2.5 – 25	2 – 20
Rated input (L:D=4,5:1)	kW	112	153	250	365
Output	kg/h	2.500 – 4.000	4.000 – 5.600	5.600 – 10.000	10.000 – 15.000
Roller-die calendar					
Roll diameter	mm	360	500	500	610
Roll length	mm	650	1.050	1.050	1.400
Sheet width	mm	500	900	900	1.200
Roll speed	min <sup>-1</sup>	2 – 25	2 – 19	1.8 – 19	1.5 – 19
Rated motor output	kW	2 x 30	2 x 74	2 x 74	2 x 95
Circumferential roll speed	r.p.m.	2.5 – 28	3 – 30	3 – 30	3.6 – 36
Roll working gap	mm	3 – 10	3 – 10	3 – 10	3 – 10
Maximum roll gap	mm	150	50/200	50/200	50/200

\* Screw length and capacity can vary, depending on actual requirements (compound recipe, max processing temperature and compound feeding characteristics).

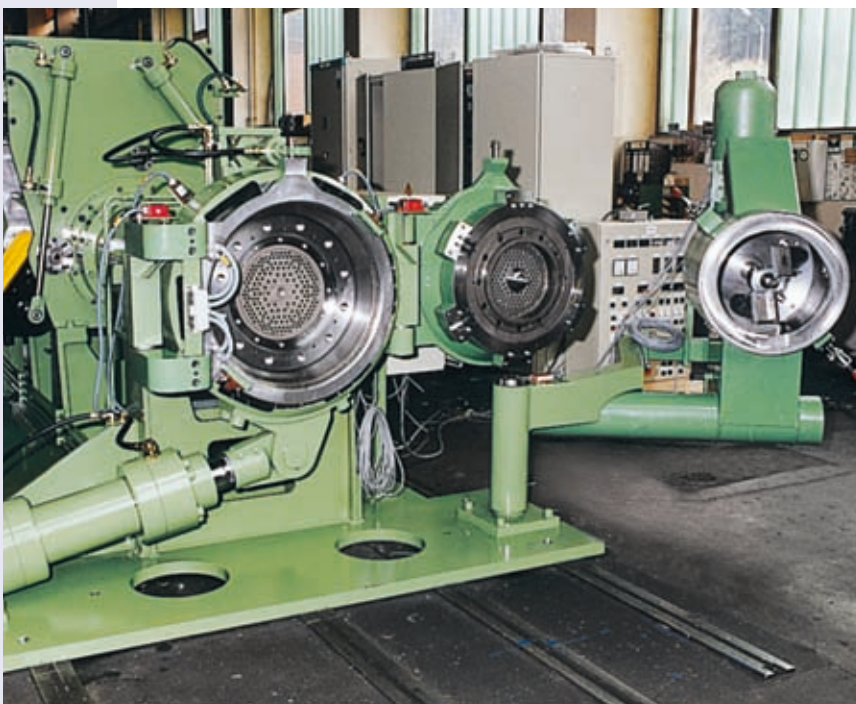


*Hydraulic twin pusher*

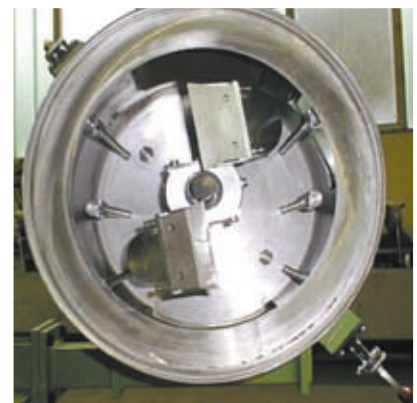
### **Twin Rotary Pusher**

The design of the patented Twin Rotary Pusher offers many advantages:

- Compact design
- Effective and reliable force transmission
- Stable bearing platform
- Effective cleaning  
(Pushers can be completely rotated out from the feed housing for cleaning)
- Tensile loads are absorbed by the sidewalls of the feed housing
- Scrapers ensure the twin pushers operate with an effective self-cleaning action
- Increased pressure build-up at low screw speeds ensures effective straining without an unnecessary rise in compound temperature



*Front view of the EAE 300 with twin strainer head*



*Rotary Cutting Head*

### Granulating Head

The granulating head consists of a steel casing with two granulating knives, knife bearings, a granulating hood and an infinitely variable speed drive. The granulating knives are easily adjustable from the outside. The granulating head casing has an inspection window and an additional duct with a video camera to monitor production. Spraying tubes spray the granulated compound with a separating anti-tack agent during the cutting process.



*Inside view of the granulating head*

### Single-screw dump extruder with swing-out roller-die calender.

Alternatively to automate the mixing line, it is also possible to operate a single-screw dump extruder with a roller-die calender, as is customary practice in the tire industry. The calender can be pushed forward or swung out for cleaning as shown in the illustration.



*Single-screw dump extruder with swing-out roller-die calender*

### **Harburg-Freudenberger**

We develop, build and distribute machines, lines and systems across our three company divisions based on 150 years of company tradition.

### **Rubber mixing technology**

We provide the most comprehensive range of machines for the rubber and caoutchouc industry including all major preparation and processing stages.

- Complete mixing room systems
- Internal mixer
- Mixing mills
- Dump extruder

### **Caoutchouc technology**

Production machines and lines for the manufacture of tires and technical rubbergoods from raw material feeding to vulcanisation:

- Extruder
- Extrusion lines
- Tire building machines
- Curing presses

### **Edible Oil Technology**

Machines for processing oilseed, crude oils of vegetable origin and animal raw materials as well as screw presses for the dewatering of synthetic caoutchouc and similar products:

- Screw presses
- Extraction lines
- Refining lines
- Process engineering

### **We are always at your service**

With our foreign offices and our service points we have a global presence.

If you would like to learn more about Harburg-Freudenberger or if you require information on specific services, please do not hesitate to contact us.



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