

SIZING TOOL

The present invention relates to a sizing tool for sizing
5 the outer dimensions of an extruded tubing.

The sleeve-like sizing tools of said type are placed immediately after a tubing extruder, in a specific sizing and cooling vat.

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The operation of the tools complies with two principles. According to one principle, a tubing in a forming state and leaving the extruder is pressed against the inner surface of the sizing tool by means of pressure developed inside
15 the tubing. The other operating principle requires a work chamber under vacuum, in which chamber the sizing tool is placed. The wall of the tool is provided with through channels, via which the vacuum prevailing in the work chamber can affect the outer surface of the tubing in the
20 sizing tool. The tubing is then sucked against the inner surface of the tool.

For cooling the tubing, the tool is either immersed in water acting as a coolant medium or the tool is subjected
25 to a constant water shower.

From the point of view of a satisfactory operation of sizing tools, it is essential that the tubing passes through the tool as free from friction as possible and that
30 the tubing leaving the extruder is correctly cooled for achieving the desired dimensions and dimensional stability.

For achieving these objects, different lubricating and cooling solutions have been developed for sizing tools.
35 These solutions related to sizing tools operating both under an internal pressure and an external vacuum have been described in patent literature to a great extent.

The sizing tool according to this invention can be adapted to be used both in pressure and vacuum systems. When it is used in a vacuum system, the wall of the sizing tool must be provided with pressure passages.

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A sizing tool provided with pressure passages and a channel system communicating with the inner surface of the tool for leading lubricating water essentially along the whole tool length between the outer surface of the tubing and the inner surface of the tool is known and described e.g. in the US patent specification no. 4 543 051.

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In the sizing tool described in said reference publication, the cooling is mainly based on the effect of cooling water in the sizing vat, although the lubricating water naturally participates in the cooling. However, arranging the cooling and the lubrication in said manner limits the tool capacity, nor does it provide a possibility of adjusting the cooling without a detrimental effect on the lubrication.

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For eliminating these problems, the sizing tool is in accordance with the invention furnished with a separate cooling channel system independent of the conditions of cooling outside the tool, which system essentially extends along the whole length of the sizing tool.

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In accordance with an essential additional feature of the invention, the sizing tool is also provided with a separate vacuum channel system similarly independent of the conditions outside the sizing tool. The other characteristic features of the invention are described in the appended patent claims.

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The invention is next described with reference to the accompanying drawing, in which

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Fig. 1 is a partially sectional side elevation of an

embodiment of the inventive sizing tool,

Fig. 2 is also a partially sectional view of another embodiment of the inventive sizing tool.

Fig. 3 is a cross-section of the sizing tool of Fig. 2 at section A-A.

10 A plastic tubing 1 to be sized is introduced into a sizing tool according to Fig. 1 from an extruder, which is not shown in the figure, but which is placed immediately in the right edge of the figure. The sizing tool is placed after a nozzle (2) of the press head of the extruder. The whole
15 sizing tool is placed in a so-called sizing vat, which is an essentially closed chamber larger than the sizing tool, in which chamber, during operation, a certain vacuum as well as a cooling water level is maintained in such a way that the sizing tool is totally immersed in the cooling
20 water. The cooling can alternatively be based on water showers, which rinse the sizing tool and the tubing protruding therefrom. The sized tubing is thus subjected to aftercooling when passing through the water or water showers in the chamber.

25 On the other hand, the inside of the tubing to be made can be arranged to be maintained at a pressure exceeding the environmental pressure, whereby the sizing occurs through this internal pressure, which pressure presses the tubing
30 wall against the inner surface of the tool.

For the operation mode under vacuum, several bores 17 have been made through the tool wall, via which the vacuum prevailing in the sizing chamber can affect the inside of
35 the sizing tool and suck the tubing to be sized against the inner surface of the tool wall.

First after a connecting flange 4, the sizing tool comprises a lubricating water chamber 22 annularly enclosing the tool. The lubricating water (which naturally has a cooling effect at the same time) is fed into this chamber via two opposite connections 7 placed tangentially to the outer surface of the wall. The bottom of the lubricating water chamber 22 has several through holes, via which water can enter between the outer surface of the tubing and inner surface of the sizing tool.

For improving the lubrication effect and extending it along the whole tool length, the tool is provided with an additional channel system 12 as an extension to the annular lubricating water chamber 22, into which channel system 12 lubricating water is led from the chamber 22 and from which lubricating water is led through holes in the channel system between the tubing and the inner surface of the tool. The channel system is extended essentially along the whole tool length and provided with its own adjusting devices 24 for achieving the correct lubricating conditions. For increasing the flow rate of the lubricating water and for equalizing the pressure, the annular chamber 22 of the initial end is furnished with overflow openings 21, through which water in excess relative to the lubrication purpose can be led to the sizing vat. A larger flow rate essentially intensifies the cooling of the inlet section. The supply of the lubricating water in the opposite direction is also possible.

In order to achieve a more controlled and efficient cooling for the tool, the tool according to the invention is furnished with separately adjusted, closed cooling-medium channels 15. The channel systems can, subject to the properties required by the product, have several operational modes e.g. with respect to the direction and distribution of the cooling circulation.

The inventive sizing tool is further especially characterized by a separate suction channel system 18. By means of a vacuum led through this suction channel system, the effect of the vacuum prevailing in the sizing vat can be intensified, the operation caused by the pressure of the inner side of the tubing can be aided, and in certain cases, the pressing of the tubing against the inner surface of the sizing tool can be solely achieved. This channel system has its own adjusting means 25.

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It is preferable to arrange said channel systems as grooves advancing on the outer periphery of a sleeve 5 forming the body of the sizing tool. These grooves are covered by a covering housing 6. The covering housing 6 can be mounted in position by means of modes known per se, one of which is a shrink fit.

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The channels are placed to pass on the periphery of the sizing tool alternately side by side, whereby there are basically two possibilities for their positioning essentially along the whole sizing-tool length. Fig. 1 shows a screw-line positioning, wherein each channel system extends as a one-head screw. Positioning comprising two or several heads is also possible. The head configuration of each screw figure related to each channel system and the applied dimensions of the channel systems define the screw pitch.

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Another possibility of positioning the channels is in the axial direction of the sizing tool, which alternative is illustrated in Fig. 2 and 3.

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There are operational differences between the positioning modes of said channel systems mainly relative to the flows of the liquid channels. A threaded positioning produces long channels, in which high flow velocities can be utilized. In addition to cooling properties, a high flow velocity is characterized by the fact that the channels remain

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clean. In a linear positioning, in contrast, high volume flows are easily produced, which on their part result in a high efficiency relative to cooling.

- 5 With respect to the device configuration, a diverse positioning of the channels causes differences mainly relative to the positioning of the connections. In the threaded mode, the connections are open directly to each channel, either directly to its initial and/or terminal end or
10 potentially also between its ends. In the linear positioning, in contrast, it is preferable to use manifolds surrounding the sizing tool, which manifolds communicate with each channel (lubrication, cooling, suction).
- 15 For extending the effect of the channels (or through-bore rows) placed on the outer periphery of the sleeve 5 and provided with passages through the sleeve wall as uniformly and efficiently as possible on the work surface of the sizing tool, i.e. on its inner surface, grooves have been
20 formed on the inner surface at the through holes of the channels. In the threaded positioning of the channels, the grooves of the inner surface advance uninterruptedly at a point corresponding to the peripheral groove, whereas in the linear positioning, the internal grooves are placed as
25 separate annular grooves spaced apart in the axial direction.

The placement of separate operational channel systems on the periphery of the sizing tool produces several operational advantages in comparison with known devices. First
30 of all, the extension of the lubricating channels along the whole sizing-tool length ensures a proper lubrication and thereby a very low-friction passage through the tool. A separate channel system also makes an independent lubrication control possible.
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From the point of view of operation, an especially impor-

tant feature of the sizing tool is the separate cooling medium channel system. Cooling can, first of all, be intensified by means of the channels in comparison with the vat cooling of prior art, and especially, the cooling effect
5 can be adjusted independent of the vat cooling. The cooling can even be reversed relative to the direction of the efficiency of the cooling, which can be achieved by changing the cooling-water supply from the inlet to the outlet or vice versa.

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A totally closed cooling circulation makes the use of other coolants than water possible, which fact can be of importance in circumstances, wherein the supply of cooling water is not sufficiently available. The cooling circulation can
15 also be combined with a separate cooling system.

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A separate and separately adjusted suction channel system makes different operational modes possible. By means of the vacuum directed from an independent channel system to the tubing, the effect of the pressure prevailing in the vat space can be intensified, whereby the pressure of the vat space can possibly be maintained nearer to the outdoor pressure. A similar effect is also achieved in connection with pressure sizing. A separate vacuum channel system is
25 very important from the point of view of the start-up of the equipment, which facilitates and speeds up the start-up phase both in connection with vacuum and pressure sizing.



CLAIMS

1. A sizing tool for extruding plastic tubing, which tool
5 by means of the inner surface of a sleeve (5) defines the
outer dimension of a plastic tubing (1) advancing from an
extruder through the tool under influence of an internal
pressure exceeding the pressure prevailing in the tool, the
wall construction (5, 6) of which tool having a lubrica-
10 ting water channel system (12) which communicates with the
inner surface of the sleeve and extends along the whole
tool length, characterized in that the tool is provided
with a separate, closed cooling medium channel system (15)
extending along the whole tool length.
- 15 2. A sizing tool according to Claim 1, characterized in
that the wall construction (5, 6) of the tool is provided
with a separate vacuum channel system (18) communicating
with the inner surface of the wall construction and ex-
20 tending essentially along the whole tool length.
3. A sizing tool according to Claim 1 or 2, characterized
in that the wall construction is provided with pressure
passages (17) to expose the surface of the tubing (11) to
25 the vacuum prevailing outside the tool.
4. A sizing tool according to any of the preceding Claims
1 to 3, characterized in that the lubricating water channel
system (12), the cooling medium channel system (15) and the
30 vacuum channel system (18) are placed as a thread configu-
ration enclosing the tool periphery and extending in its
longitudinal direction in the form of one or several head
thread.
- 35 5. A sizing tool according to any of the preceding Claims
1 to 3, characterized in that the lubricating water channel
system (12), the cooling medium channel system (15) and the



vacuum channel system (18) are placed in the longitudinal direction of the tool and alternately distributed along the whole tool periphery.

- 5 6. A sizing tool according to Claim 3 or 4, characterized in that the pressure passages (17) are placed as a row complying with the advancement pattern of the channel systems (12, 15, 18).
- 10 7. A sizing tool according to any of the preceding Claims 1 to 6, characterized in that the lubricating water channel system (12), the vacuum channel system (18) and correspondingly the pressure passages (17) are connected with the grooved channel system (13, 19, 16) formed on the inner
15 surface of the cylinder wall.
8. A sizing tool according to Claim 4, 6 and 7, characterized in that the grooved channel system (13, 19, 16) of the inner surface of the sleeve is placed to match the flow
20 channel system (12, 18), correspondingly the row of the pressure passages (17).
9. A sizing tool according to Claim 5 and 7, characterized in that the grooved channel system of the inner system of
25 the sleeve is formed as annular grooves spaced apart in the axial direction of the tool, which grooves communicate with a corresponding flow channel (12, 18) or pressure passages (17).
- 30 10. A sizing tool according to any of the preceding Claims 1 to 9, characterized in that the flow channel systems (12, 15, 18) are formed as grooves covered with a mantle (6) on the outer surface of the sleeve (5).