The Study of the Grossing Process in the Grosses of Fluted Type

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ABSTRACT: This paper gives information about device of gross for fabrication of polymeric fluted sheet, capacity of grosses, the experimental study of the hydrodynamic characteristic of the melt form of the polymeric materials and the characteristic features of toughness of the fluted sheet. Authors gave special emphasis on reological features, factor of volume increasing, moisture cheese, toughness at spraining and density fluted sheet. © 2006 Wiley Periodicals, Inc. J Appl Polym Sci 103: 72–80, 2007

Key words: grossing method; fluting; polyvinylchloride; thermoelements; hydrodynamic characteristic; moisture

INTRODUCTION

The world-wide use of polymeric material allows to say with confidence that this high-tech, solely time-proof, and multifunctional material presents an enormous interest for specialist who are occupied in different spheres of the designing and construction. The extrusion-calender method with heating ferry swingletree and the grossing method are the often used methods of conversion of polymeric material.

The literature analysis[1] shows that, for production of product using polyvinylchloride as the base, the extrusion-calender method is more labor-consuming and requires greater material and energy expenditure in contrast with the grossing method. So, question of development of equipment to produce product from polymeric material by grossing method is more appropriate. The construction of gross for fabrication of polymeric fluted sheet was made.[2]

DEVICE OF GROSS FOR FABRICATION OF POLYMERIC FLUTED SHEET

The device of gross for fabrication of polymeric fluted sheet contains the swingletree, profile-molding surfaces, which is executed fluted, in the manner of protuberant and concave curves crooked second order. For ensuring the stable grossing process is realized, heating swingletree at thermoelements was done. There is controlled clearance between swingletree for ensuring that the necessary thickness got fluted linen.

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Valicuyuschiy mechanism contains front and the back swingletrees, set coaxis up with clearance. The surface of the swingletree is executed in the manner of parabolic salient and troughs. Thermoelements, having a steel tube with electro-isolation material wound on it and protected by a layer of the asbestos filament 8, are provided for heating swingletree (Fig. 1).

For counting the rotation, front and the back swingletrees warm material rages in the clearance between the two grosses and subjected them to deformation. The required thickness of fluted sheet is provided by clearance between both swingletrees and varies within 2–4 m, fixed with account high-elastic characteristic of the material, and valued by factor of swell. The salients and troughs form curly polymeric sheet. Width is defined as requirements to profile of the final product and ranges from 180 to 225 mm.

Installed thermoelements and are used for heating worker part of gross until the temperature required for conversion of the material under investigation is reached. To prevent combustion of electroisolation material, asbestos filament is reeled on its surface. In increasing the deformation of the material, the difference in the temperature between swingletree plays an important role, since the adhesion of material and removal of the ready fluted sheet are produced with more heating of gross. The temperature of front gross exceeds that of back gross by 10–15 K.

Installation works as follows. The worker part of gross is heated until the temperature required for conversion of the material under investigation is reached, to give the voltage on thermoelements, presenting realize is sailed. The necessary clearance for functioning (working) between swingletree is installed by means of the press mechanism. The value of

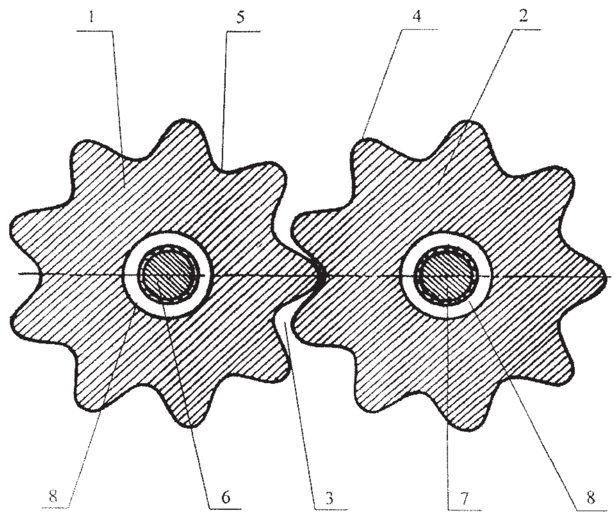


Figure 1 A transverse cut of the grosses. 1, The front gross; 2, the back gross; 3, the clearance between the two grosses; 4, parabolic salient; 5, a parabolic trough; 6 and 7, the thermoelements; and 8, asbestos filament.

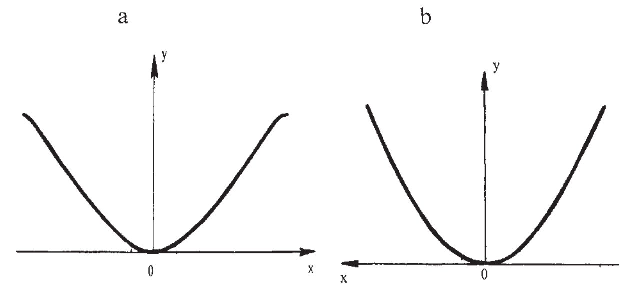


Figure 3 A curve of the second order forming trough (a) and forming salient (b).

the clearance check on limb scale on mechanism of the regulation of the clearance accurate to 0.2 mm. The warmed material in the clearance is loaded between the two grosses. Then, the "Starting" button on shield of management, whereupon swingletree begins to revolve toward to each other, is pressed. The material rages in the clearance between the two grosses are subjected to deformation. For increasing the deformation of the material, the difference in the temperature between swingletree plays a major role.

Thermoelements are used for heating worker part of gross, until the temperature required for the conversion of the material under investigation is reached. The exterior of the thermoelement is shown in Figure 2.

Thermoelements consist of a metallic tube, on which the electroisolation material (mikanit) is wound. To prevent the combustion of mikanita (the short circuit between pipe and wire), asbestos thread or asbestos linen is reeled on its surface.

The nichrome thread (cross sections of 0.4 mm^2 at 220 V) is reeled on asbestos linen. General diameter of the thermoelement is 16–18 mm. In order to prevent short circuit between the nichrome wire and side of the shaft 4 on the end of a tube, we put a ring from a ceramic material on in diameter of 20 mm. Other end of the tube bolt threading joins in rolling full tilt, which moves the parallel axis of gross. For improvement exchange by heat between of the thermoelement and wall of the gross on pipe put on the bushing is put on, external diameter which on 2 mm internal diameter of the gross less on output.

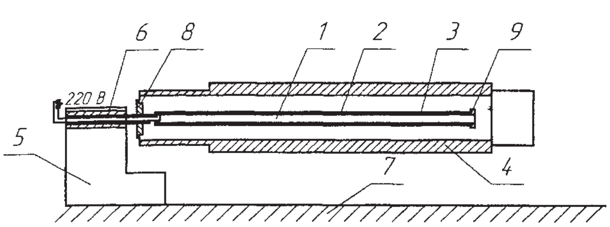


Figure 2 An exterior of thermoelements. 1, a tube; 2, electro-isolation material; 3, a tungsten wire; 4, a wall of gross; 5, a handhold for the thermoelement; 6, the fastening for tubes; and 7, mount.

The volume of the trough fluted of the gross choose from condition of the seizure of the maximum volume of the material, sufficient for shaping the fluted sheet of the required thickness. The maximum volume of the seized material under minimum surface swingletree provides the cylindrical trough for the following compression of the material, however, and alerts that shift deformation is required for the reduction of the volume to cavities, in which the material is found. Coming from foregoing, choosing surfaces of the salient (the troughs) surface second order, the equation is in the form of:

$$y = k \cdot x^n, \qquad (1)$$

where y is an ordinate point crooked, mm; k is constant crooked, mm^{-1}; x is an abscissa point crooked, mm; and n is a factor degree.

The optimum curvature to surfaces obtained, answering above-named condition, is described by eq. (1) under $n = 2$, $k_1 = 0.16$ mm^{-1}, $k_2 = 0093$ mm^{-1}, where k_1 is constant crooked describing salient of curly; k_2 is constant crooked describing trough of curly [Figs. 3(a) and 3(b)].

CAPACITY OF GROSSES

Capacity of grosses depends on the type of cheese, the recipe of mixture, designs of grosses and powers of their drive, and changes over a wide range. The purpose of calculation is to determine the amount that got fluted sheet at an hour (the unit of time).[2] The volume V of the loading mixing and warm grosses is usually defined by the following empirical formula:

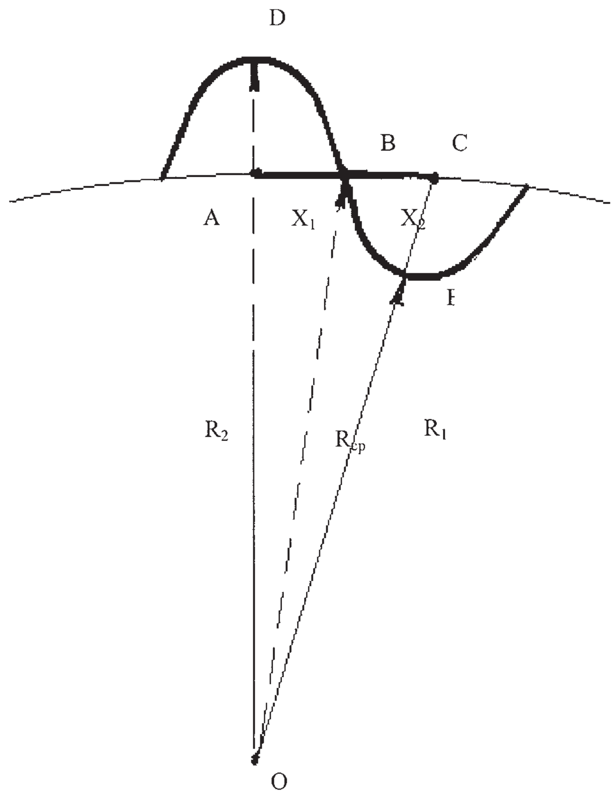


Figure 4 Length of one period to fluted surface.

$$V = LD_{cf}K, \tag{2}$$

where V is the volume of the loading; L is the length worker part of the gross; K is the utilization ratio worker part of the gross (to = 60–85); D_{eff} is an efficient diameter of the gross, m.

The efficient diameter D_{eff} is defined by the formula:

$$D_{\mathrm{eff}} = 2R_{\mathrm{eff}} \tag{3}$$

where R_{eff} is an efficient radius of the gross, m.

The efficient radius of the gross presents itself as radius of the cylindrical surface, whose length is a length to surfaces fluted of the gross. The determination of the length to surfaces fluted of the gross will allow us to define capacity of the installation. For this, the length of one period to fluted surface (Fig. 4) coming from given geometries of curly is defined.

The ordinates point crooked trough and salient are defined from equations:

$$y_1 = k_1\, x^2{}_1 \tag{4}$$

$$y_2 = k_2\, x^2{}_2 \tag{5}$$

where y_1 is an ordinate point crooked salient, mm; k_1 is a constant crooked salient, mm^{-1}; x_1 is an abscissa point crooked salient, mm; y_2 is an ordinate point crooked trough, mm; k_2 is a constant crooked trough, mm^{-1}; and x_2 is an abscissa point crooked trough, mm.

Abscissa point crooked salient x_1 is defined by length of the length AB, but abscissa point crooked trough x_2 is defined by length of the length BC (Fig. 4).

$$R_2 - R_1 = d \tag{6}$$

where R_2 is the radius of the salient, m; and R_1 is the radius of the trough, m.

Using the obtained correlations (4), (5), (6), the dependencies for determination of the abscissas point crooked salient and troughs are found.

$$x_1 = \sqrt{\frac{d}{k_1\left[\frac{k_1}{k_2} + 1\right]}} \tag{7}$$

$$x_2 = \frac{k_1}{k_2}\sqrt{\frac{d}{k_1\left[\frac{k_1}{k_2} + 1\right]}} \tag{8}$$

Substituting eqs. (7) and (8) in eqs. (4) and (5) we get:

$$y_1^1 = k_1 x_1^2 = k_1 \frac{d}{k_1\left[\frac{k_1}{k_2} + 1\right]} = \frac{d}{\frac{k_1}{k_2} + 1} \tag{9}$$

$$y_2^1 = k_2 x_2^2 = k_2 \frac{k_1{}^2}{k_2{}^2} \frac{d}{k_1\left[\frac{k_1}{k_2} + 1\right]} = \frac{k_1}{k_2} \frac{d}{\left[\frac{k_1}{k_2} + 1\right]} \tag{10}$$

One salient and two parabolic crooked are formed, whose length $l1$ is defined by means of determined interval under X [0;$x1$] by formula (11):

$$l_1 = \int_0^{x_2} \sqrt{1 + \left(\frac{dy_1}{dx}\right)^2}\, dx = \int_0^{x_1} \sqrt{1 + 4k_1^2 x^2}\, dx$$

$$= \frac{1}{2} x \sqrt{1 + 4k_1^2 x^2} + \frac{1}{2} \cdot \frac{1}{2k} \ln[2k_1 x + \sqrt{1 + 4k_1^2 x^2}] \Big|_0^{x_1}$$

$$= \frac{1}{2} x_1 \sqrt{1 + 4k_1^2} + \frac{1}{4k_1} \ln[2k_1 x_1 + \sqrt{1 + 4k_1^2 x_1^2}] \tag{11}$$

One trough and two parabolic crooked are formed, whose length $l2$ is defined similarly:

$$l_2 = \frac{1}{2}x_2\sqrt{1+4k_2^2x_2^2} + \frac{1}{4k_2}\ln[2k_2x_2 + \sqrt{1+4k_2^2x_2^2}] \quad (12)$$

The salient and trough form the length of one period to fluted surface L:

$$L = 2l_1 + 2l_2 = \sum_{i=1}^{2}\left(x_i\sqrt{1+4k_i^2x_i^2} + \frac{1}{2k_i}\ln[2k_ix_i + \sqrt{1+4k_j^2x_j^2}]\right) \quad (13)$$

The number period is defined by attitude:

$$N = \frac{2\pi R_{cp}}{2(x_1+x_2)} = \frac{\pi R_{cp}}{x_1+x_2} \quad (14)$$

where Rcp = OV (Fig. 4).

The length of the fluted sheet for one turn L_1 is defined as making the length of one period to fluted surface on number period, and is expressed in the manner of:

$$L_1 = NL \quad (15)$$

$$2\pi R_{3\Phi\Phi} = NL \quad (16)$$

To determine the efficient radius fluted of the gross, the values of the length from eq. (14) are substituted and eq. (16) is solved:

$$R_{eff} = \frac{\pi R_{cp}}{2\pi(x_1+x_2)}\sum_{i=1}^{2}\left(x_i\sqrt{1+4k_i^2x_i^2} + \frac{1}{2k_i}\ln[2k_ix_i + \sqrt{1+4k_i^2x_i^2}]\right) \quad (17)$$

THE EXPERIMENTAL STUDY OF THE HYDRODYNAMIC CHARACTERISTIC OF THE MELT FROM THE POLYMERIC MATERIAL AND THE CHARACTERISTIC FEATURES OF TOUGHNESS OF THE FLUTED SHEET

The experimental study of the hydrodynamic characteristic of the melt from the polymeric material and the characteristic features of toughness of the fluted sheet were conducted on two-grosses installation design, using the earlier stated principle of the work.

The experiments realizable for study of the grossing process can be possibly divided into two groups:[3]

1. The study characteristics of polymeric material, influencing upon grossing process and defining its parameters: the reological characteristic feature of the polymer pertain specific characteristic, such as crooked currents, the factor of increasing the volume, and the contents of moisturizing in source raw material.
2. The study characteristics of profile sheet by grossing method. As follows, the dependencies to mechanical toughness of the linen, its density, and hydrostability from conditions of the conversion polymer in products are installed.

The reological characteristics of polymeric material defined by two capillaries E.B. Begly method, concluding in determination of the features pressure formed outflow of the polymer melts from two capillaries of the different length.[4] The final dependencies are obtained for fixed temperature in the manner of $\varphi_{eff} = f(\tau_{ist})$, where φ_{eff} is the efficient fluidity melt, $(Pa\ s)^{-1}$; and τ_{ist} is the voltages of the shift, Pa.

The factor of increasing the volume and allowed contents of moisturizing in source raw material is defined after fabrication on designed installation fluted sheet. Depending on the numbers of turn swingletree (15–30 turn/min), the temperature (393–453 K), and the time of grossing (1–12 min) made, the sample fluted sheet is selected, for which the degree of the increase area cross section sample (the factor of increasing the volume) and moisturizing en masse is fixed.

The maximum content of moisture in source raw material is specified for event of the use secondary polymer, i.e., obtained at conversion departure (presence of moisture is conditioned stage from washing polluted polymeric departure, directed for reception secondary polymeric cheese).

The hydrostability of material fluted sheet defined in size hydroabsorb (in mass %) for 24 h. The dependencies of the specified factor from density of the fluted linen are installed.[4]

The features of grossing process are defined—-as for conditions of the unceasing process (using prewarmed polymer)—-under one-shot passing of the polymeric material through molding clearance, and so for periodic mode of grossing.

In the course of experimental study of the grossing process, we used the following polymeric material:

- a high-pressure (low density) polyethylene of the mark 15,802–020 (PVD). This was used as a universal material model, allows to produce the benchmark analysis with other wide-spread polymeric material and match their hydrodynamic characteristics feature in different conditions of the conversion material in final products.
- the cable plasticate (PVH) of the mark O-40. PVH was used as one of the recommended material, in the most degree, suitable to fabricate fluted sheet by method of grossing.

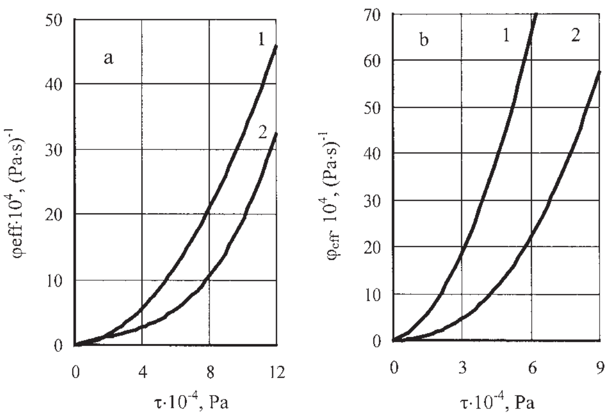


Figure 5 A dependencies to fluidity melt from voltage of the shift PVD marks 15802–020 [1, $T = 423$ K; 2, $T = 403$ K] (a); and cable plasticate marks O-40 [1, $T = 433$ K; 2, $T = 443$ K] (b).

Reological features

The curves of the current melts of PVD and PVH are received in the manner of dependencies of efficient fluidity melt φ_{eff}, (Pa s)$^{-1}$, from voltage of the shift τ_{ist}, Pa, under different temperature of the conversion. Curves of the current required for quality estimation and optimum mode of the conversion polymer are shown in Figure 5.

As a result, the optimum temperature of the grossing of PVD is 403–423 and PVH is 433–443 K.

The current polymer is accompanied by an elastic deformation in melt, so that whole complex mechanical relaxation phenomena appears, which can cause (i) change in sizes of the product in contrast with molding clearance (the increasing of volume products), (ii) roughness and even the jaggy on surfaces product, and (iii) distortion of the form of the product.[5]

The influence of elastic characteristic of polymer melt on quality of the final product great so estimation quality of the polymer only on fluidity absolutely insufficient and simultaneously must be given estimation to resilience of the melt.[5]

Factor of volume increasing

The relaxation dug in grossing process of voltages influences upon quality product and reveals itself in the manner of volume increasing, occurring under the action of normal voltages—-a perpendicular direction of the moving the mass melt. The normal voltages appear in consequence of longing of the oriented molecules to move over to slack condition (the Vaysenberga effect).[6]

With reference to grossing process under factor of volume increasing, K, m^2/m^2, the attitude of an area molding clearance of the gross S, m^2, to area of the cross section of the fluted sheet S_1, m^2, i.e., $K = \sqrt{S/S_1}$ is understood.

For polymeric material factor $K > 1$, which is conditioned by processes of the high elastic recovering of the melted mass of the polymer at passing through molding equipment or a molding gap.[6]

For PVD 15,802–020 and PVH O-40, the dependency of the factor of volume increasing from number of turn swingletree is installed. The temperature of the grossing process for PVD was found in interval 403–443 K and for PVH in the interval 423–453 K; the number of turn changed step-like from 15 to 30 turn/min. The clearance between the two grosses in given series is exposed equal, $\Delta = 3.0$ mm. At attaining the given temperature of grossing, the required number of turn swingletree from row 15, 20, 25, and 30 turn/min are installed. In clearance between the two grosses (the value which is adjusted with accuracy 0.2 mm) loaded under investigation warmed up polymeric material. Grossing of fluted linen is produced from average part, which sliced the sample by width 50–60 mm. The sample obtained is gradually cooled in silicone bath (for relaxation of the voltages in material). Beside cooled sample the area of the cross section S_1 is defined and correlated with area molding of the clearance between the two grosses, S.

The dependency of the factor from number of turn swingletree $K = f(n)$ is shown in Figure 6.

Figure 6 shows increase in the factor of volume, increasing (both for PVD and for PVH) at the average of 5–6%, when the number of turn swingletree is increased with 15–30 turn/min. This is explained by growing (in unit of time) dug in polymeric material of the springy deformation, conditioned by significant shift voltages under grossing.

Besides, it is necessary to note that, on increasing the temperature within operating range 403–453 K, final importance of the factor of volume increasing increases on 3–6%.The factor of volume increasing for

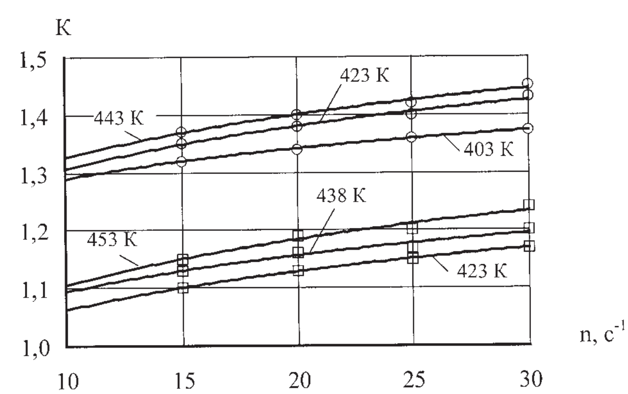


Figure 6 A dependency of the factor of volume increasing polymeric material from number of swingletree turn (clearance between two gross $\Delta = 3$ mm). PVH marks O-40 (□); PVD marks 15802–020 (○).

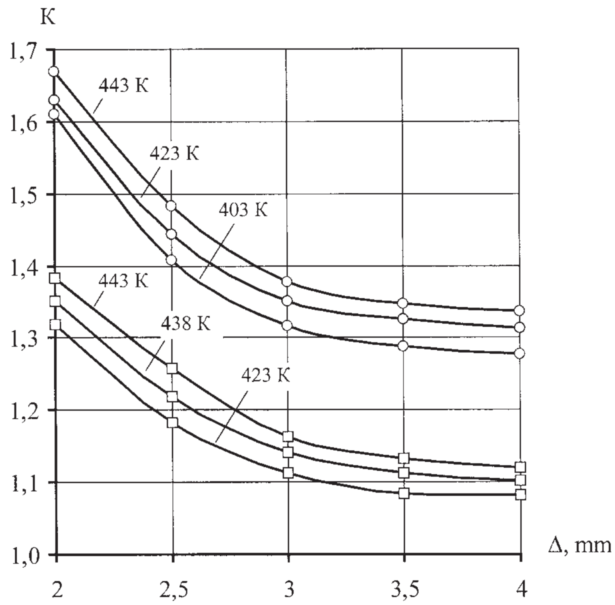


Figure 7 A dependency of the factor of volume increasing polymeric material from value clearance between two gross. PVH marks O-40 (□); PVD marks 15802–020 (○).

PVD marks 15,802–020 formed K = 1.32–1.45; for PVH O-40, K = 1.10–1.24.

Alongside with determination of the dependencies of the factor of volume increasing from number of swingletree turn, the influence upon value K clearance between two grosses is also defined, which varied within the range Δ = 2.0–4.0 mm. In accordance with Figure 7, the explored polymer factor of volume increasing increases with reduction clearance between two grosses, which is explained by an increase in the increasing force in clearance between two gross, and accordingly, shift deformation en masse melt.

The PVH factor of volume increasing changed within the range of K = 1.28–1.67 and at reduction of the thickness of the fluted sheet with 4.0 to 2.0 mm increase on 25–26% at the average.

The PVD factor of volume increasing formed K = 1.08–1.38, increasing with reduction of the thickness of the sheet on 22–24%.

Experimental study results were used at variation of the sizes clearance between two grosses, for ensuring the guaranteed thickness fluted sheet.

Moisture cheese

The account to moisture polymeric cheese necessary when using secondary polymer (the departure of the primary conversion) are subjected to the preliminary washing from contamination. The humid polymeric raw material is hereinafter reduced, melted, and moved on to grossing for fabricating fluted sheet (toughness product from secondary polymer falls on 10–20%, and is however found in possible for usage product range).

Moisture source cheese and grossing masses of the polymer are defined according to the previous work,[6] on change of the mass after endurance sample under 378 K for 60 min.

Raised moisture of the material brings appearance of ВЛаГИ on surfaces of the product and brings about blowing (the bladder) on card face sheet.

In the process of work, grossing compositions PVH marks O-40 and PVD marks 15,802–020 were installed, such that satisfaction of the linen forming and removing the vapor(s) of water of the mass begins at contents moisturizing in raw material not more than 10–12%. Otherwise, the failure of the mass with swingletree occurs, since surplus amount moisturizing prevents the process of plastication.[6]

At intermittent grossing processes, the remaining contents moisturizing in polymeric material w, %, are defined, considering that practically duration of the cycle by the grossing formed τ = 1–12 min.

The dependencies for polymer under investigation were provided in correspondence with Figure 8 in the manner of $w = f(\tau)$.

As a result, under maximum initial moisture of the downloaded polymer—10–12% already in 5–6 min of grossing mass on fluted swingletree, remaining moisture linens falls to acceptable level (less than 0.3–0.4% for PVH and less than 0.1%, for PVD).

Hereinafter, for revealing best state of working, ВаЛЬЦеВ with profile swingletree and studies characteristic ready fluted sheet from PVD and PVH, installed the dependencies from the temperature and time of grossing: toughness of the fluted linen, i.e., destroying voltages at sprain, density of the material of the final product. The influence to density of the polymer on its absorption by water is defined.

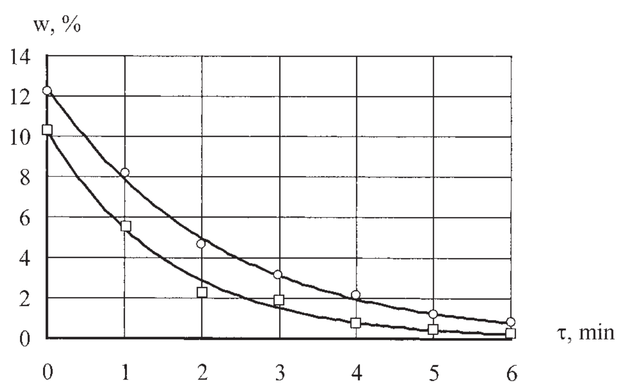
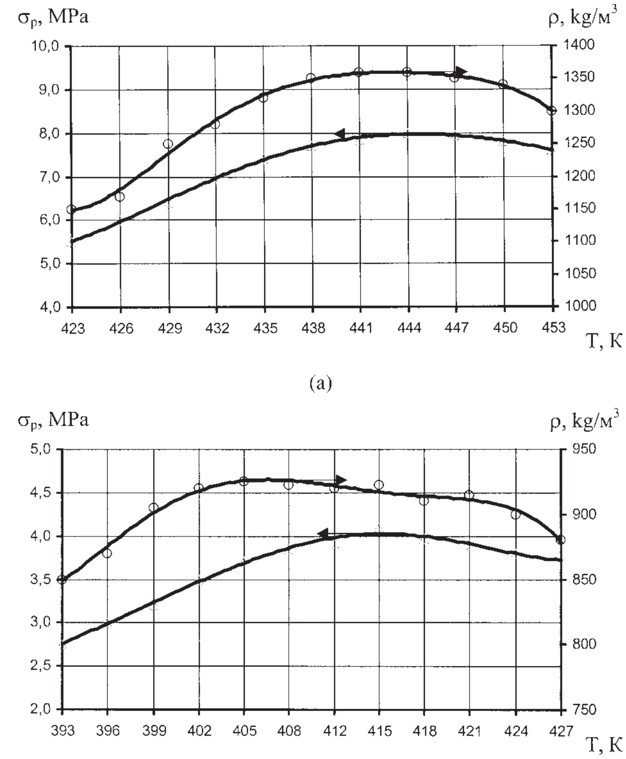


Figure 8 A graph representing the change in the contents of moisturizing in polymeric mass in the grossing process. (□)—PVH marks O-40 (T = 413 K); (○)—PVD marks 15802–020 (T = 438 K).



(b)

Figure 9 A dependency destroying voltages and density of the fluted sheet from temperature of the grossing process. (a) Material PVH; (b) material PVD.

Toughness at spraining

The study of toughness characteristic of polymeric fluted sheet, made from PVD and PVH, was concluded in undertaking the test on sprain under constant velocity of loading, according to GUEST 12,580.

The sample in the form of square-wave bands, obtained by grossing, bolted in grip of the explosive machine MR-05–1, whereupon (at the temperature indoors 18–22°C) with constant velocity, the spraining effort before breakup sample was put. At moment of the destruction sample was fixed the destroying load, N. Destroying voltage at sprain σ_p, Pa, can be calculated by the formula:

$$\sigma_p = \frac{P}{S_0} \tag{18}$$

where P is the destroying load, N; and S_0 is an area of the initial cross section, m^2.

The results of the studies of toughness features of polymer are shown in Figure 8, in the manner of dependencies $\sigma_p = f(T)$, where T, is the temperature in grossing process, K.

For PVH marks O-40 in interval of the temperature of grossing 423–453 K, toughness sample at sprain formed 5.5–8.0 MPa (the thickness of the fluted sheet, 4.0–4.5 mm). Moreover, in recommended range of the conversion PVH in fluted sheets (433–443 K), destroying voltage was found within the range of 7.2–8.0 MPa.

For PVD marks 15,802–020, toughness sample at sprain formed 2.8–4.1 MPa (in interval of the temperature 393–427 K). In worker interval temperature of 403–423 K, destroying voltage was equal to 3.7–4.1 MPa.

Note that toughness of the feature of the product from PVH is exceeded in two times the specific factors for PVD: maximum toughness fluted sheet from PVH—-8.0 MPa, from PVD—-4.1 MPa, which confirms the motivation choice as construction material for fabrication fluted sheet cable plasticate marks O-40.

Density fluted sheet

Obtained under different warm-up and temporary mode, sample fluted sheet defined the dependency to density from the temperature and time of grossing.

The sample under investigation was weighed on analytical weight of the type VLA-200 M accurate to 0.1 mg. Range of the temperature of grossing for PVH is 423–458 K and for PVD is 393–443 K. The time of grossing changed from 1 to 12 min. The area of the cross section sample [(0.9–1.0)10^{-3} m^2] was formed at thickness of 4–4.5 mm. Results of the determination to density of the material sample depending on the temperature of grossing are shown in Figure 9(a, b).

In accordance with Figure 9(a), density fluted sheet from PVH was maximum at the temperature 443–448 K and formed 1350–1360 kg/m^3. For PVD, maximum density reached 920–925 kg/m^3 in interval of the temperature 403–413 K. Joint graphic scene of the dependencies destroying voltages σ_p, MPA, and density of

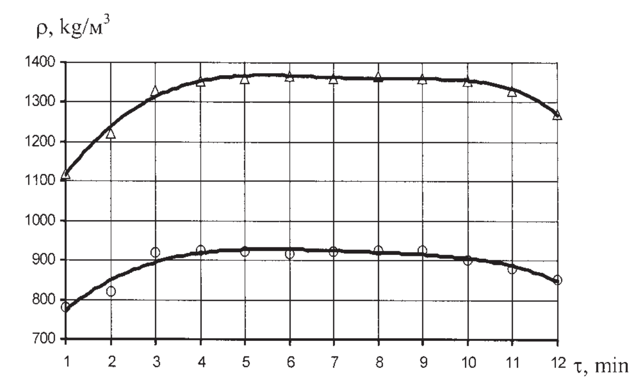


Figure 10 A dependency to density of the fluted sheet from time of grossing.

the fluted sheet ρ, kg/m^3, from the temperature of the grossing process T, K, has allowed to install the correlation between value σ_p and ρ.

It is installed such that most of density corresponds for PVH is 1360 kg/m3 (under $T = 443$ K) and for PVD is 925 kg/m^3 (under $T = 408$ K).

The dependency to density of the polymeric fluted linen from time of grossing is defined with reference to intermittent process of the reception fluted sheet. For this evenly loaded (not warm) PVH or PVD in clearance between two grosses, the swingletree was heated to the temperature of grossing, and the grossing loaded portions of the polymer was provided during determined time from range $\tau = 1$–12 min. Provalicovannoe linen was taken out of swingletree, and for selected sample, the density fluted sheet was defined. The results to dependencies $\rho = f(\tau)$ for advisable temperature of grossing are shown in Figure 10.

It is installed such that the operating range of grossing time corresponds to the following density fluted sheet: for PVH, 1340–1360 kg/m^3 (time of grossing 4–10 min); for PVD, 915–925 kg/m^3 (time of grossing 4–9 min). Optimum time required for processing the material by the grossing is 5–9 min.

Water-stability of fluted sheet

The interaction of the molecules of water with polymeric material in the most full measure is characterized so named "diffusion constant"—a factor to permeability (moisture-permeability) P, factor to diffusions D, and factor h. In ditto time at the study of the influence of water on characteristic material use and the other terms and notions, such as hygrosaturation, sorption, adsorption, water-stability, and others, reflecting essence and condition of the experimental studies and corresponding to methods.

To study the characteristic of fluted sheet in persisting work, we used the water-stability factor for forecasting the behavior of the final products in process of the usages at contact with moisture. The water-stability got fluted sheet expressed through the absorption of water factor, ξ (%), characterizing increase in the general mass sample for count of the absorption moisture from surrounding ambiences, during specified length of time (24 h or 30 day). The collation of the obtained importances was conducted with similar feature for polymeric material, specified in reference literature.

Figure 11 shows the experimental dependencies of water-absorptions of sample from PVH and PVD-ξ (%), from density fluted sheet.

For cable plastic compound of marks O-40, the minimal water absorptions at $\xi = 0115\%$ was observed at density of the linen at p = 1360 kg/m^3 that corresponds to the maximal density from a working range

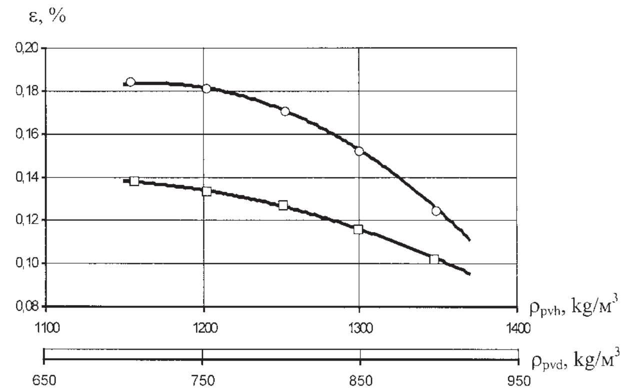


Figure 11 A dependency of water-absorption linen from density. (□)—-PVD marks 15802–020 ($T = 413$ K); (○)—-PVH marks O-40 ($T = 438$ K).

on temperature processing (a sample is received by continues grossing at temperature of the gross $T = 443$ K). For PVD marks 15,802–020, minimum water absorption at $\xi = 0096\%$ existed at density of a sheet at $\rho = 925$ kg/m^3 ($T = 423$ K).

FINDINGS

1. As a result of studies of high viscosity and elastic characteristic of melt to compositions PVH marks O-40 and PVD marks 15,802–020 curves of the current are built and is determined factor of volume increasing of melts, as well as possible contents moisture in source raw material is installed.
2. It is installed such that, at the temperature of the grossing process $T = 403$–453 K, factor of volume increasing K increases (both for PVD and for PVH) at the average on 5–6% when the number swingletree turn increases with 15–30 turn/min.

   For composition PVH, factor of volume increasing changed within the range of $K = 1.28$–1.67, and at reduction, the thickness of the fluted sheet with 4.0–2.0 mm increased by 25–26% at the average. For PVD, importance of the factor of volume increasing formed $K = 1.08$–1.38, increasing with reduction of the thickness of the sheet by 22–24%.
3. It is revealed that satisfaction of forming the linen and degazation of masses of the polymer begins at contents moisturizing in raw material not more than 10–12%. It is installed such that, in 5–6 min of grossing mass on fluted swingletree, remaining moisture linens falls to acceptable level, i.e., less than 0.3–0.4% for PVH and less than 0.1% for PVD.
4. Toughness fluted sheet at sprain for composition PVH marks O-40 in interval of the temperature of grossing 433–443 K formed 7.2–8.0 MPa. For PVD marks 15,802–020, the interval of the tem-

perature of grossing formed 3.7–4.1 MPa (T = 403–423 K).

5. Density-fluted sheet from composition PVH was maximum at the temperature 443–448 K and formed 1350–1360 kg/m^3. For PVD, maximum density is 920–925 kg/m^3 (T = 403–413 K). Optimum time taken for processing the material by grossing was 5–9 min.
6. It is installed such that, with growing of density of the material fluted sheet, the water absorptions falls and for PVH marks O-40 at density of the linen 1360 kg/m^3 forms 0.11%; for PVD marks 15,802–020, 0.09% at density of the linen 925 kg/m^3.

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