PLAINTIFF'S EXHIBIT
CT-1450

asbestos-cement manufacturing technology

based on work by Dr. **I. I. Berney** — part III

Equipment used for the investigation of the process of filtration.

Any apparatus which is to be used for the investigation of the process of filtration, must, in lines of principle, correspond in construction and method of operation to the filters used in the actual process of manufacture.
The filters commonly used in laboratories, are simple funnels of different types. The conditions of filtration through these funnels, are differing considerably from the conditions of filtration through the sieve cylinder moulds of the manufacturing machines.
In funnels, the asbestos-cement particles stick to the bottom rapidly and consequently the study of the filtration of suspensions having large size particles (as are the asbestos-cement suspensions) is quite impossible because it would be for instance impossible to determine the influence of the speed of rotation of the sieve cylinder on the process of filtration.
It has therefore been necessary to devise a special apparatus simulating as near as possible real manufacturing conditions.

The special filter and auxiliary equipment.

This special piece of equipment is shown in fig. 8. It consists of the filter (1), a 36 litre capacity tank containing the suspension to be filtrated (2), a vacuum pump (3), an electric timer (4), switching arrangements (5), a water vacuum metre (6). The tank is fitted with a one pallet horizontal agitator which is electrically operated and rotates at 160-180 revs/m. On the tank are fitted vertically the coils (7) on which the frame (8) and the filter can move. The contact arrangements of the electrical timer are placed on the left coil and a magnetic switch is fitted on the right coil (9). Timer and switch are arranged in such a way that when the sieve wire of the filter (10) is half-immersed in the suspension, the timer goes into action and the vacuum pump starts when the centre of the sieving wire is 10 cms. below the surface of the suspension.
The vacuum pump stops when the filter is taken out of the suspension and the timer will stop when the filter will return to the position corresponding to the moment of the beginning of the process. The vacuum pump goes into action 15-20 seconds after the beginning of the process and secures the start of filtration on account of the difference of pressures corresponding exactly to the operating conditions of the sieve cylinders of the forming machines.
Fig. 9 shows the body of the filter, the frame and the rubber tube joining the body of the filter to the vacuum pump. The filtrating surface of the filter has an area of 64 cms. square. The body of the filter, fixed on the frame, can rotate on its axis and can be positioned at any angle.
More details can be seen in figure 10, body (1), screen (2), tube for the connection to the vacuum pump (3), plug (4), bronze cover (5), undercover (6), base (7) — made of perforated brass sheet. The screens used on the special filter are similar to those used with the forming machines' sieve cylinders. The covering wire and the undercover are fitted on a bronze frame (8) at the edge of which is fitted a rubber gasket (9) of 2 mms. thickness for tightness. The filtrating screen is held tight by means of a ring (10) screwed to the frame.
It is necessary to note that filtration time « t », indicated by the timer corresponds to the time the filtrating screen is in the suspension up to the horizontal line crossing its centre.
When the filtrating screen is at a certain angle in respect to its horizontal surface area, the time the lowest point of the screen is in the suspension, will be greater than « t » and its value will be « t + Δt ». Accordingly the time the highest point

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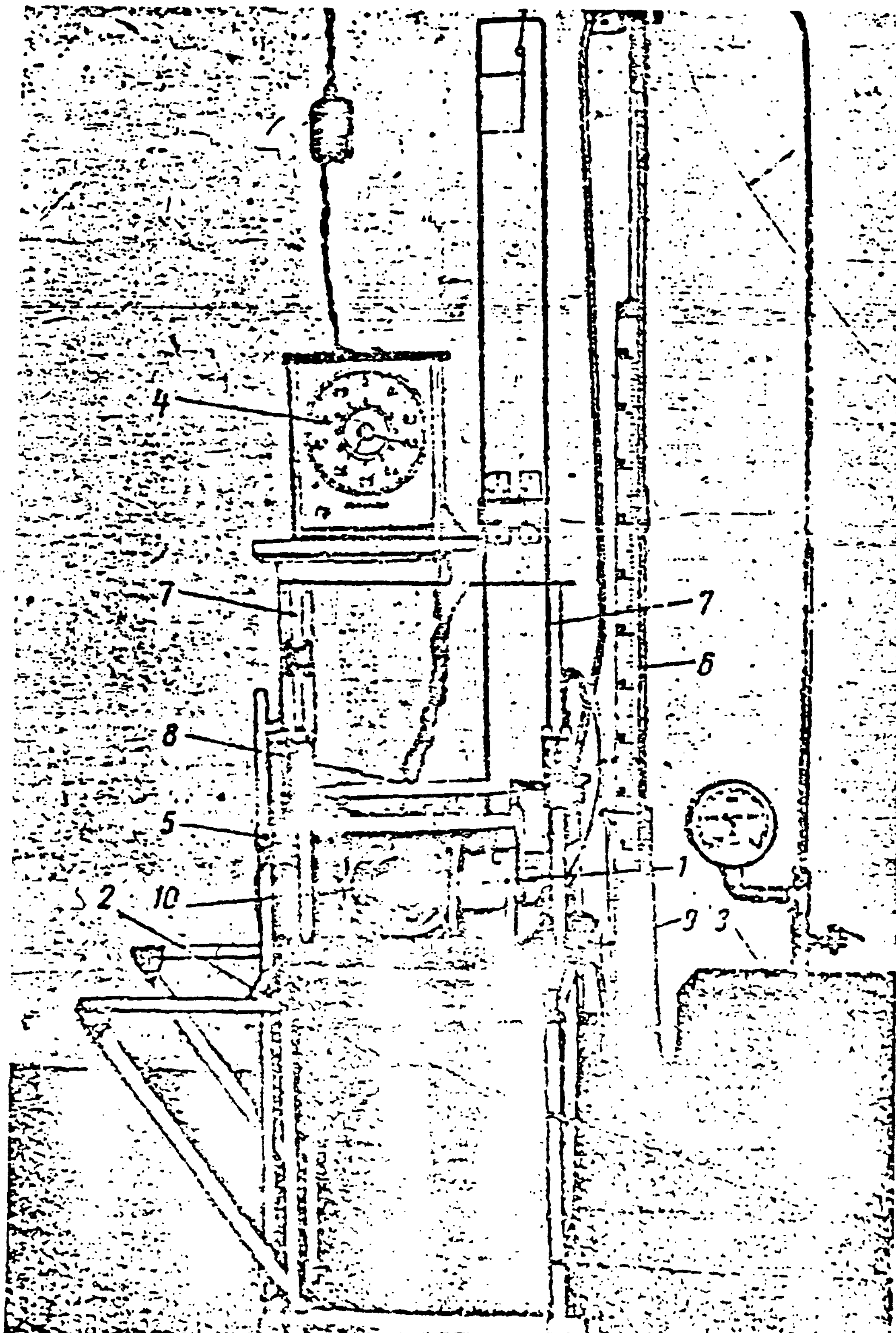

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Fig. 8. - The special filter and auxiliary equipment.

of the screen is in the suspension, will be « t — Δt ». At an angle of 30°, which coresponds to the conditions under which most of the experiments were carried out, the value of Δt varied between 0,06-0,10 seconds, and was in average 0,08 seconds.
When the filtrating screen is in a horizontal position, Δt is obviously equal to zero.
The correctness of the measurements of the volume of filtrated material and determination of the solid particles which passed through the filtrating screen, is secured by the fact that all the material remains in the body of the filter on account of the special form of the body and of the position of the vacuum tube on the axis.
The position of the filtrating screen on the axis of the body, secures the constancy of hydrostatic pressure at different angles of inclination.
The influence of filtration conditions of the asbestos-cement suspension on the physical mechanical properties of asbestos-cement products, was also studied and for this purpose another filter having a filtrating surface in the form of a rectangle, was manufactured (see fig. 11).
Cakes measuring 100 × 120 mms. were formed from a number of layers obtained by means of the equipment shown in fig. 11; the method of manufacture of the samples will be explained later.
The special filter allows to study the influence on filtration of all the factors with the exception of the speed of rotation of the filter.
The data obtained from the experimental work carried out with the Special Filter concern separately the various stages of the process of filtration and the notion regarding the process as a whole can only be grasped after the analysis of the complete data and in order to do this another piece of equipment had to be constructed: a filter having a cylindrical filtrating screen.

The filter with a cylindrical filtrating screen.

This piece of equipment shown in fig. 12, consists of a vat (1) agitator (2), a drum (3). The drum consists of two parts fixed on a hollow roll having radii of 500 and 600 mms respectively. The diameter of the smaller part of the drum and its position in the vat correspond to the size and position of a 1000 m/ms sieve cylinder of a forming machine. On the surface of this part of the drum, a box (4) with a filtrating screen is fixed. (See fig. 10).

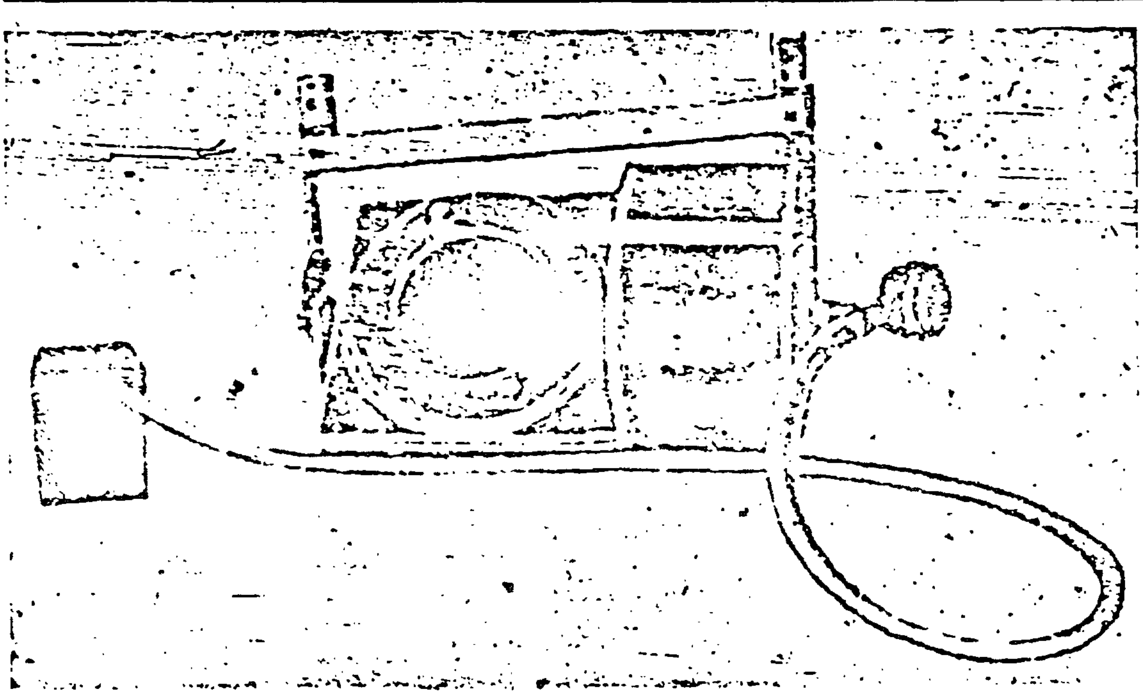

Fig. 9. - Particulars of the special filter.

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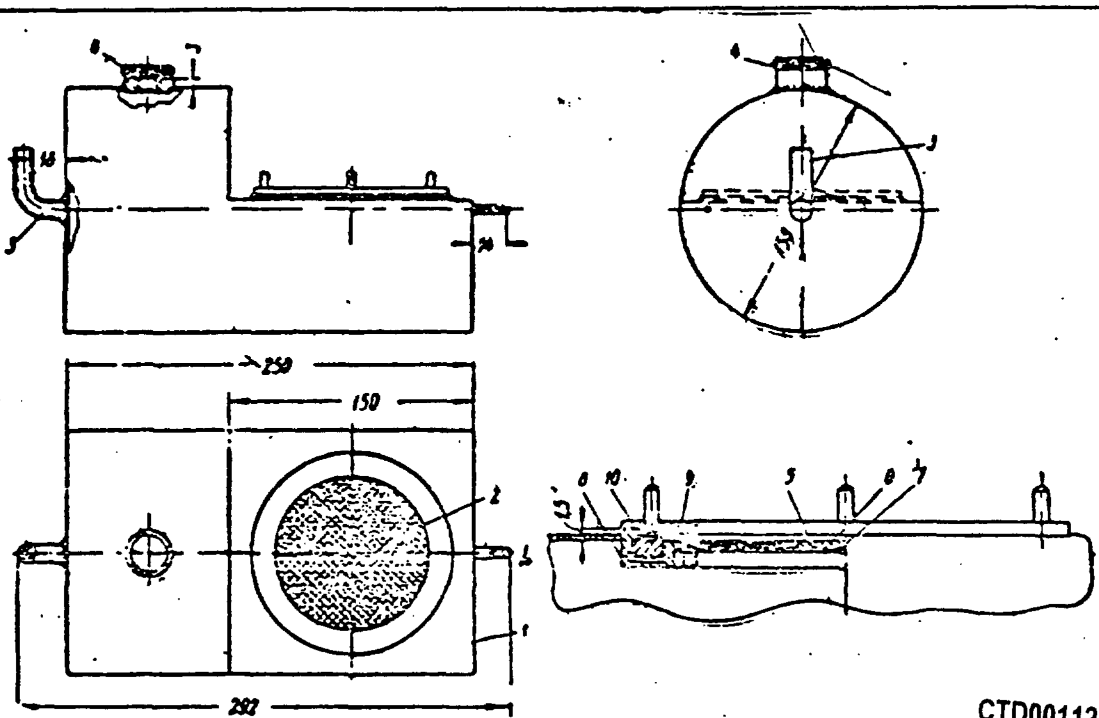

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Fig. 10. - The special filter - three views.

During filtration, the box is in contact with the atmosphere through the hollow roll. Two tubes (5) serve to discharge the material from the box. When these are open, the filtrated material in discharged into special collectors (6) which are placed in the inside part of the drum with the bigger diameter. When they are closed, the filtrated material remains in the box. The collectors are so fixed on the roll (7) that during the rotation of the drum, they remain immobile.
The size of the collectors and their position are calculated to contain in each of them the quantity of filtrated material obtained during predetermined equal intervals of time.
The duration of filtration is measured by a process timer. Spy windows (8) are fitted for control purposes.
For the purpose of controlling the data obtained from the experiments carried out on the above explained laboratory equipment, a pilot-size sheet machine was used having the following characteristics:

Number of sieve cylinders	4
Diameter of sieve cylinders	300 m/ms.
Working width of felt	500 m/ms.
Total filtrating area of each sieve cylinder	4720 cm²
Actually filtrating area of the sieve cylinder	3070 cm²
Diameter of the formation drum	500 m/ms.
Diameter of the anvil roll	90 m/ms.
Speed of felt	8-28 m/min.

The machine is shown in figure 13.
During the experiments, the machine was operated with one or two sieve cylinders.
The asbestos-cement suspension used was prepared in a hollander having the following characteristics:

Total volume	150 litres
Diameter of drum	345 m/ms.
Length of drum	333 m/ms.
Revolutions of drum per minute.	120

The suspension was fed into the machine fro: mixer the volume of which is 300 litres.
A series of experiments was also carried out on a factory full size sheet forming machine having the following characteristics:

Number of sieve cylinders	2
Diameter of sieve cylinders	850 m/ms.

(21)

(21)

Working width of the felt	1600 m/ms.
Actual filtrating area of each sieve cylinder	2,75 m^2
Maximum hydrostatic pressure during filtration	45 cms. w/h.
Volume of the sieve cylinder vats	870 litres
Diameter of the forming roll	1200 m/ms.
Diameter of the Anvil roll	300 m/ms.
Speed of felt	18-38 m/min.

Asbestos-cement suspension was prepared in a hollander having the following characteristics:

Total volume	3 m^3.
Diameter of drum	950 m/ms.
Length of drum	1100 m/ms.
Revolution of drum per minute	220

Methods of experimentation.

With the special filter. The filter, fixed on the frame is immersed into the suspension. After a determined period of time, the filter is taken out of the suspension and removed from the frame. The filtrated material is discharged from the body of the filter into a measuring cylinder and is filtrated once more for the purpose of determining the content in it of the solid phase. The upper wire of the filtrating screen carrying the sediment, is removed carefully, weighed and put in a dryer.
Before starting a new operation a completely new upper wire is applied.
The purpose of the work carried out on this piece of equipment was to determine the ratio: volume of filtrated material/weight of layer, and time of filtration with pressures varying from 10 to 270 cms. w/h and concentration of suspension varying between 5 and 15%.
The experiments were carried out with time of filtration varying between 1 and 6 seconds at intervals of 1 second.
A separate series of experiments were carried out with time of filtration equal to 60 seconds. Each experiment was repeated two to three times.
At the moment of filtration, the position of the wire can differ. The position will be defined by the angle between the vector of filtration (always in a direction perpendicular to the surface of the wire) and the vector of the force of weight from the same point of the surface of the wire, see figure 14. This will be

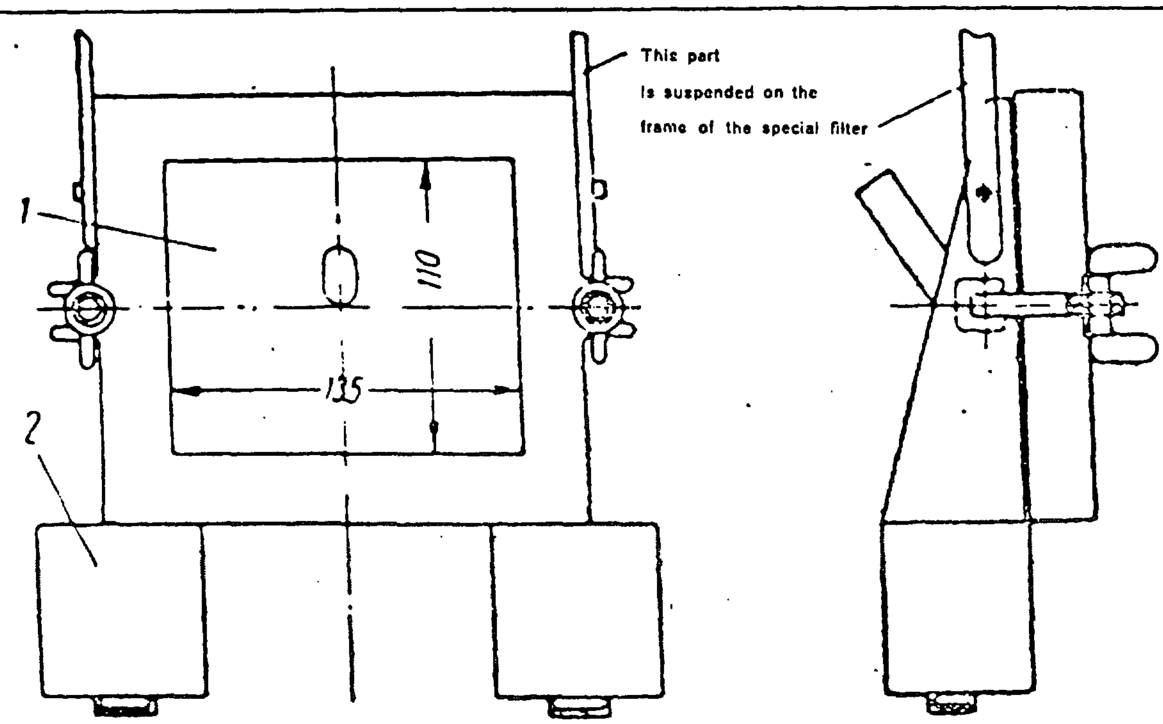

Fig. 11. - Filter with rectangular filtrating surface: 1. Filtrating surface; 2. Collectors for filtrated material.

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referred to as the angle of inclination and expressed by the letter ψ. The angles of inclination for the experiments conducted on the Special Filter, varied between 60° and 135°.

After removal, the covering wire of the filter was weighed both wet and dry for the purpose of determining the weight of the layer wet and dry. Asbestos-cement cakes were made in the following manner. The filter shown in figure 11 was immersed in the suspension, suspended in such a way that the angle of inclination was 120°. This position was chosen because it gave a coefficient of collection of asbestos-cement, from the total volume of the filtrated material, equal to approximately 0,83 which corresponds to the average values obtained from the factory machines. After a certain time equal to the average time of filtration on the sieve cylinders of the machines operating in factories, or established according to charts, the filter was taken out of the suspension and the undercover, the covering wire carrying the layer and a piece of wet felt were all pressed at 3 Kgs/cm².

As a result of the applied pressure, the first dewatering of the layer took place and the layer was picked up by the felt. A second layer was pressed in the same way but using this time the felt on which a first layer was already deposited thus simulating conditions of machines operating with two sieve cylinders. The felt carrying the double layer was placed on the platform of the press with the layer facing upwards and on which a smooth metal plate was placed. The material was pressed again at a pressure corresponding to the specific pressure of the harvester roll; at this stage the layer was undergoing the second dewatering and was detached from the felt and adhered on the metal plate. This operation was followed up to obtain the required thickness of the sample.

The original cake measuring 120 × 100 m/ms. was cut in 6 parts each measuring 20 × 100 m/ms. Three of the samples served for determining moisture content and strength. The other three served for flexural strength, specific weight and water absorption after half a day's hardening.

The layers with which the samples were made, were obtained with different times of filtration, hydrostatic pressures and concentration of suspension. The influence of the conditions of filtration on the

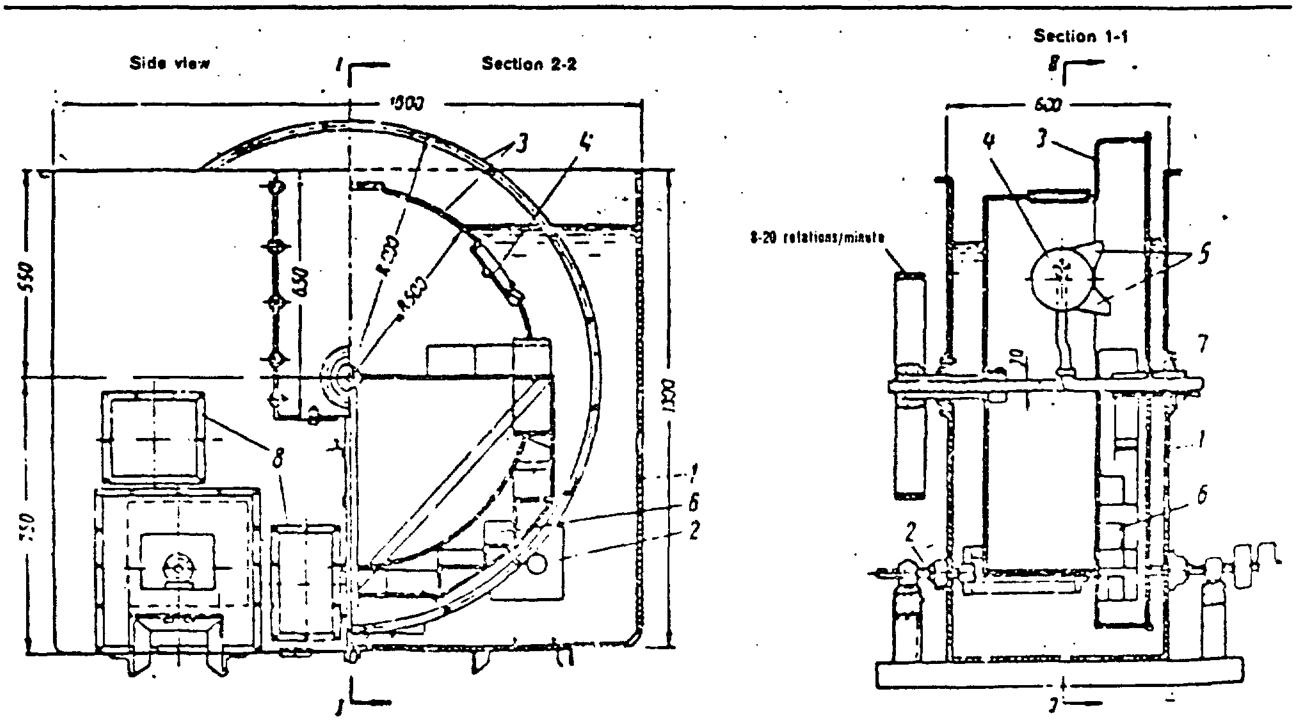

Fig. 12. - Filtration equipment with cylindrical filtrating surface.

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physical mechanical properties of the asbestos-cement samples was also investigated.

With the filter with cylindrical filtrating screen. After filling the vat with asbestos-cement suspension to the required level, the drum was allowed to make one revolution with the tubes of the filtrating box closed. After that, the covering wire carrying the sediment was removed and the filtrated material was discharged from the box and measurements were taken of the volume and of the quantity of the solid phase contained in the filtrated material. The delivered layer was weighed both dry and wet. Similar experiments were carried out with the tubes of the filtrating box open and the volume of the filtrated material in each collector was also measured. By changing the speed of rotation of the drum, the influence of this speed on the process of filtration was determined with the help of adequate equipment. The suspension for this series of experiments was prepared in the hollander of the pilot-size sheet forming installation and was used one hour after cement was added. The temperature of the suspension was measured at the beginning and end of the experiment. Fineness of grinding of cement was checked before using it.

With the pilot-size experimental equipment. The suspension used for this series of experiments was identical to that used for the experiments carried out with the laboratory equipment. To secure stability of operations, the equipment was fed with suspension having constant concentration. No dilution was made and the process was under continuous observation in order to maintain constant the level of the liquid in the vat. In order to prevent any increase in volume of the filtrated material in the course of these operations, even the washing of the sieve cylinder was stopped.
On completion of each operation, the volume of filtrated material through the sieve cylinder was measured and also samples taken.
The thickness of the asbestos-cement elementary layer was calculated by dividing the thickness of the formed sheet sample by the number of layers or complete turns of the harvester roll. Samples of the layer for moisture content measurements, were taken by placing under the couch roll a piece of

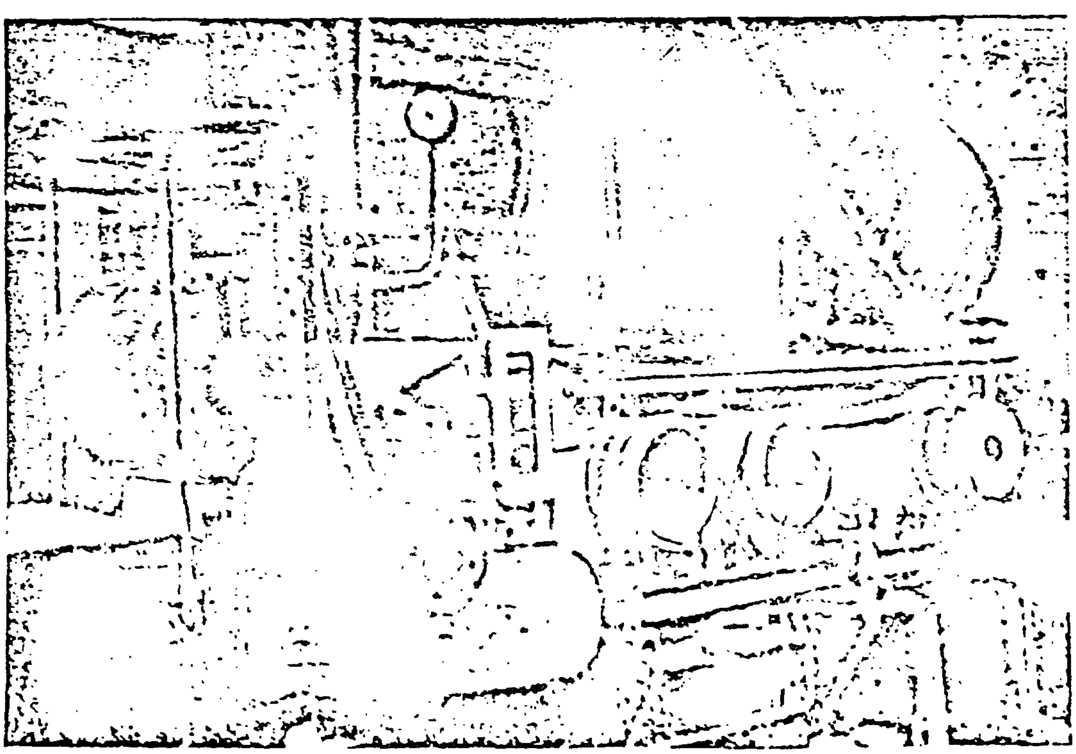

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Fig. 13. - Pilot-size sheet forming machine.

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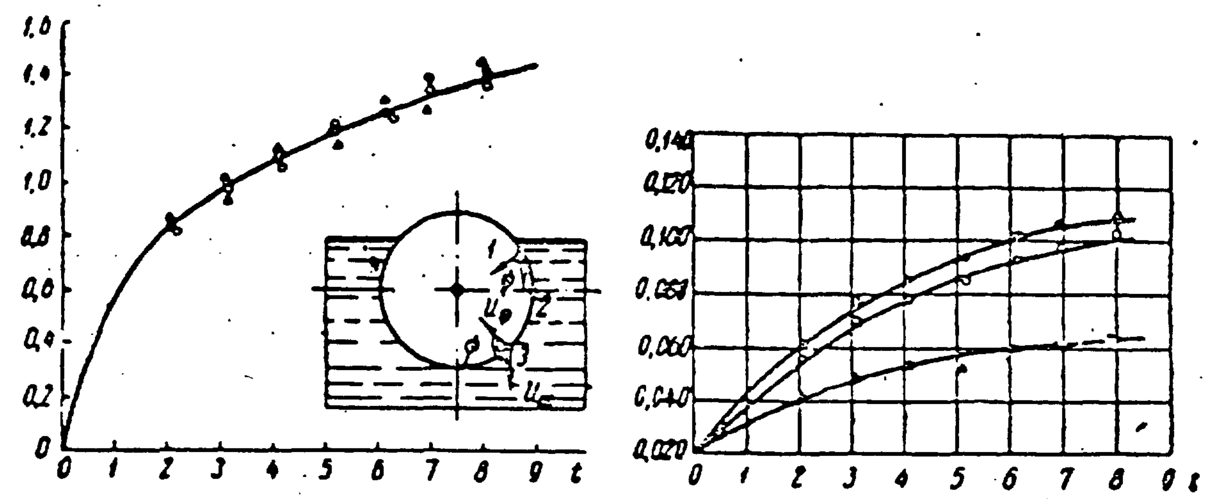

● 60°; O 90°; ▲ 135°; a = 0,08 g/cm³; P = 40 g/cm².

Fig. 14. - The influence of the angle of inclination of the wire on the volume of filtrated material and weight of the layer.

paper on which the layer detached from the felt, stuck. The moisture content of the freshly formed sheet was also measured immediately after its cutting off from the harvester roll.

The volume of the hollander of this installation is calculated to give a number of sheet samples of 6 mms thickness. After completion of each operation, the equipment is stopped and put into action again only after the preparation of a new quantity of suspension. Each experiment was repeated two to three times.

With the factory machine. The method adopted in the course of experiments carried out on a factory sheet forming machine, differed only slightly from the previous method.

The sieve cylinder vats of the forming machine were fed with suspension without additional dilution, and the level of the suspension in the vats was allowed a variation of 3 cms.

The temperature of the suspension, the volume of the filtrated material, the thickness of the layer, the quantity of asbestos and cement in the filtrated material, the moisture content of the layer and of the sheet samples and the level of the suspension in the vats, were all measured in the course of each operation.

The machine was operated with different felt speeds ranging between 17,7 and 37,8 metres/minute.

After formation, the samples were cut in square of 400 × 400 mms.

The samples were subsequently allowed to harden in humid-air at temperatures ranging between 28-30° C. Samples were tested for mechanical strength, water absorption, compression and bending after 7, 14 and 28 days.

The investigation of asbestos-cement suspension. The investigated suspensions were differing both in types of asbestos fibres and properties of cement used. Furnishes of different composition and cement with different specific surface and composition were used. Also fibre was milled to different degrees of openeness. Concentration varied from 5-15 %, pressure from 10-270 cms. w/h., temperature from 15-35° C; age of suspension from 15 minutes to 3 hours. The intensity of mixing also varied.

An asbestos-cement suspension having the following characteristics was filtrated in order to establish the relation between the volume of filtrated material and time of filtration:

Solid phase: 15 % asbestos fibre and 85 % cement.
Furnish: 50 % grade 5 chrysotile and 50 % grade 6 chrysotile.
Cement type 400. Fineness of grinding, residue on screen 4900 equal to 7,6 %.
Pressure during filtration: 40 cms. w/h.
Concentration: 0,08 gm/cm³.
Angle of inclination of wire of special filter: 60°, 90°, 135° (see fig. 14).
Table 2 contains the different values obtained

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Analysis of the experimental data. Investigation of filtration for the determination of the productivity of the sieving media, was undertaken many years back by the chemical and other industries. An equation of filtration was established for determining the productivity of the filters on the basis of experimental work. In order however to assess if this equation can be applied when studying the filtration process of asbestos-cement suspensions, and also its application for the calculation of the productivity of the sieving media, a general examination is necessary. The above referred equation of filtration was constructed on equation (2-14)

$$\frac{dV}{dt} = \frac{P}{\eta r_g c(V + V_0)} .$$

But equation (2-14) can only be used when specific resistance of the layer is constant and does not depend on t and V and specific resistance can only be constant when layers are not pressed. In the pressed asbestos-cement layers, as stated before, the size of the pores in the different sections of the layer is not equal and depends on the pressure of the liquid and consequently the specific resistance is not constant.

The dependance of the specific resistance of the layer on pressure, can be expressed, on the basis of experimental data, by the following equations:

$$r_g = r_1 P^s \tag{2-15}$$

or

$$r_g = r_1(1 + a_1 P^s) \tag{2-16}$$

where: a_1 coefficient determined by experiments.

r_1 coefficient of proportionality.

s capacity of layer to be pressed.

As compactness of the layer is not uniform under the action of hydrostatic pressure, so specific resistance is not constant.

For calculations, it would only be necessary to consider the average value of the specific resistance of the layer.

The average specific resistance of the layer or the average value of $r_1 P^s$ with change of pressure from 0 to P_1, can be determined using equation (2-15):

$$r_{gc} = \frac{r_1 P^s dP}{P_1} = \frac{r_1 P_1^{s+1}}{(s+1)P_1} = r_1' P_1^s$$

and

$$r_1' = \frac{r_1}{s+1}$$

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Table 2

Filtration of Asbestos-Cement suspension on the special filter.

$P_\phi = 40 g/cm^2$. $a = 0{,}08$ g/cm³. $T = 20°$. $\eta = 9{,}91$ g.sec/cm².

Angle of inclination of wire	Specification of values	Serial N°	Average time « t » seconds						
			2,01	3,08	4,06	5,15	6,14	6,95	8,05
60°	Volume of filtrated material per unit of surface of filter, at time « t »	1	0,84	1,02	1,09	1,20	1,27	1,37	1,42
90°	Same	2	0,83	0,97	1,08	1,23	1,27	1,36	1,38
135°	Same	3	0,85	0,98	1,13	1,18	1,31	1,29	1,44
	Same (average value)	4	0,84	0,99	1,10	1,20	1,28	1,34	1,41
	Average $P_\phi \dfrac{\Delta\left(\frac{t}{V}\right)}{\Delta V}$ g.sec/cm⁴ . .	5	195	207	240	255	270	290	
	Average volume of filtrated material between registrations (cm³/cm²)	6	0,91	1,04	1,15	1,24	1,31	138	
	Delivery (average value in g/cm²)	7	0,0086	0,0089	0,0084	0,0091	0,0089	0,0084	0,0087
60°	Weight of layer at time « t » per unit of surface of filter «G» (g/cm²)	8	0,062	0,076	0,085	0,094	0,102	0,107	0,108
60°	Average specific resistance « r_{gc} ». cm/g.	9	525	543	622	652	682	745	
60°	Coefficient of collection $Ky = \dfrac{G}{aV}$	10	0,92	0,96	0,97	0,98	1,00	1,00	0,96
60°	Weight of layer $c = \dfrac{G}{V}$ delivered by 1 cm³ of filtrated material (g/cm³)	11	0,074	0,077	0,078	0,078	0,080	0,080	0,077
90°	Weight of layer G g/cm²	12	0,056	0,070	0,078	0,085	0,093	0,098	0,103
90°	Coefficient of collection Ky . .	13	0,83	0,88	0,89	0,89	0,91	0,91	0,91
90°	$c = \dfrac{G}{V}$ g/cm³	14	0,066	0,070	0,071	0,071	0,073	0,073	0,073
135°	Weight of layer « G » g/cm² . .	15	0,042	0,048	0,053	0,052	0,060	0,062	0,064
135°	Average specific resistance « r_{gc} » (cm/g.)	16	789	863	1080	1150	1170	1280	
135°	Coefficient of collection Ky . .	17	0,62	0,61	0,60	0,54	0,59	0,58	0,57
135°	$c = \dfrac{G}{V}$ g/cm³	18	0,050	0,049	0,048	0,043	0,047	0,046	0,046

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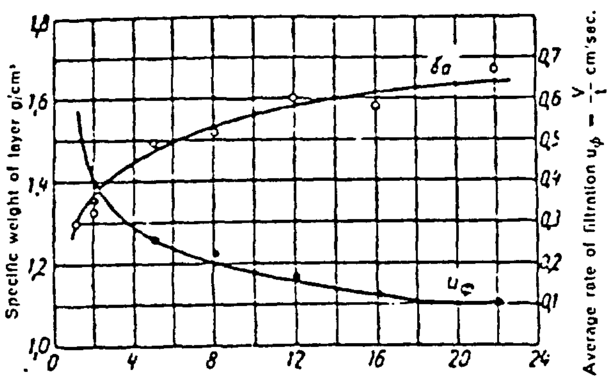

Fig. 15. - Change of the specific weight of the layer in relation to average rate and time of filtration.

suspension, a layer of 1 mm thickness is obtained and that this layer is divided into two equal parts of 0,5 mm each, the compactness and specific resistance of that part of the layer nearer to the wire will be the greater, and the average specific resistance for the whole layer can be determined by the equation and will be equal to $r_1' \cdot P_1^s$.

Similar experiments were made with the same suspension but with filtration times of 5, 7 etc seconds., maintaining the same pressure P_1. In these cases layers of always greater thickness were obtained and with an always greater compactness near the wire. The specific resistance of the elementary layer will, of course be different but as calculations are based on the average specific resistance, this will always be expressed by $r_1' \cdot P_1^s$. As pressure P_1 is constant and r'_1 and s remain the same with the same suspension, it follows that the average specific resistance of the whole layer will be constant.

Equation (2-14) can therefore be applied for pressed layers but it would be necessary to substitute in the equation « r_g » with « r_{gc} », standing for the average value of the specific resistance of the whole layer. This substitution in equation (2-14) will give after integration:

$$t = \frac{\eta \cdot r_{gc} c}{2P} V^2 + \frac{\eta \cdot r_{gc} c}{P} V_0 V \qquad (2\text{-}17)$$

when constants:

$$\frac{\eta \cdot r_{gc} c}{2P} = b_\phi$$

and

$$\frac{\eta \cdot r_{gc} c}{P} V_0 = a_\phi$$

then the following can be obtained:

$$t = b_\phi V^2 + a_\phi V$$

or

$$\frac{t}{V} = b_\phi V + a_\phi \qquad (2\text{-}18)$$

The equation (2-18) can be applied for determining the productivity (determination of V) of the filter media filtrating suspensions with particles that can be pressed.

It is to be noted that the two values in equation (2-17) (average specific resistance « r_{gc} » and weight of the layer « c » delivered from 1 cm³ of filtrated material) do not depend on the volume of filtrated material but are in relation to the quantity and properties of the solid particles of the suspension. It is therefore necessary first of all to establish if these values are really constant as equation (2-18) demands, before investigating the filtration of asbestos-cement suspension. It is also necessary to establish that these do not depend on time of filtration and volume of filtrated material. This control work on the constancy of « r_{gc} » and « c » is a check of the possibility to apply the known equations of filtration for the calculation of the productivity of sieve cylinders. « r_{gc} » and « c » can be calculated on the basis of the data on filtration of asbestos-cement suspension referred in table 2.

The value of « c » can be determined by dividing the weight of the layer by the volume of filtrated material (11, 14, 18 - Table 2).

Differentiation of equation (2-18) for « V » and substitution of the differentials with the value of the increase will give the expression for the calculation of the average specific resistance of the layer:

$$\frac{\Delta\left(\frac{t}{V}\right)}{\Delta V} = b_\phi = \frac{\eta \cdot r_{gc} c}{2P}$$

which gives:

$$r_{gc} = \frac{2P}{\eta c} \cdot \frac{\Delta\left(\frac{t}{V}\right)}{\Delta V} \qquad (2\text{-}19)$$

For the calculation of the average specific resistance. when filtrating asbestos-cement suspension, see Nos. 9 & 16 table 2. The analysis of the data referred in table 2 indicates that the filtration of asbestos-cement suspension differs substantially from filtration of other suspensions, the most important particularities being:

1. During the process of filtration of asbestos-cement suspension, the average specific resistance

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of the layer is increasing continuously in the course of the build-up (9 & 16, table 2). Every gram of asbestos-cement delivered on the wire increases the specific resistance by a value greater than that of the previous gram.

2. Average specific resistance increases not only when time of filtration is increasing; such increase is also noted when time of filtration is constant but the angle of inclination of the wire « ψ » is different (see 9 & 16 table 2). For equal times, the volume of filtrated material or average rate of filtration is the same for layers obtained at angles of inclination of $\lesseqgtr 90°$ (see table 2, and graph fig. 14).
This circumstance would not require an explanation if the weight of the layer was not depending on the angle of inclination « ψ » but in this case a phenomenon of particular nature takes place i.e. with same pressure and time, the volume of filtrated material through a layer of considerably greater weight obtained with an angle of inclination « ψ » $< 90°$ will be equal to the volume of the material filtrated through a layer of lesser weight and thickness but obtained with an angle of inclination « ψ » $> 90°$. The answer cannot be the greater compactness of one layer compared to the other as both layers are obtained with exactly equal pressures. The only possible explanation, therefore, is that in spite of the fact that the same suspension was filtrated, the particularities of the process account for the formation of layers of different structure; with the angle of inclination $> 90°$, the size of the pores of the layer formed with the same external pressure, is smaller and consequently the average specific resistance greater; with the angle of inclination $< 90°$, the pores of the formed layer are bigger and specific resistance smaller.

3. The wieght of the sediment delivered per volume-unit of filtrated material is not constant and decreases considerably with « ψ » $< 90°$. (see values of « c » with « ψ » $= 90°$ and $135°$). This is of particular importance and deserves further examination. In this respect the determination of the weight of the layer will firstly be examined.

TABLE 3.
Ratio: Asbestos/Cement in an asbestos cement layer in relation to its thickness

Thickness of layer in cms.	Percent content after heating		Ratio asbestos/cement
	CaO	MgO	
0,012	47,67	13,46	0,32
0,017	50,58	11,03	0,25
0,032	52,95	9,84	0,21
0.048	52,71	9.50	0,20

Assuming that all the solid particles of the filtrated suspension are delivered on the wire, then the sediment will contain the particles which were in the liquid and passed through the filter as well as the particles retained in the pores of the layer. Knowing the moisture content of the layer, « W » then the quantity of liquid in its pores can be calculated and multiplication of this value by the concentration of the suspension « a » will give the weight of the solid particles in the layer.
Therefore the weight of the sediment per volume-unit of filtrated material, can be calculated by the formula:

$$c' = 1 \cdot a + a \frac{c'W}{100 - W}$$

or

$$c' = \frac{a\,(100 - W)}{(100 - W) - aW} \qquad (2\text{-}20)$$

Considering that the average moisture of the laye on the wire is 68 % and that concentration of the suspension used for the experiments was 0,08 g/cm³, then using equation (2-20):

$$c' = 1{,}20\,a.$$

In practice, however, all the solid particles do not deposit on the wire as a certain quantity is carried away by the filtrated material, the average quantity being, for the first 5 seconds as figures in table 2 indicate, approximately 10 % of the weight of the particles contained in the filtrated suspension. If this 10 % is deducted from the weight of the layer, the result will be:

$$c = 0{,}90\ (1{,}20a) = 1{,}08a.$$

If during the process of filtration, all the solid particles contained in the suspension, with the exception of those carried away by the filtrated material, would deposit on the wire, then « c » would be approximately equal to the concentration of the suspension. However figures indicate (see Nos. 11, 14 & 18 table 2) that only when the angle of inclination « ψ » $= 60°$, « c » is approaching the value of the concentration « a » $= 0{,}08$ whereas when « ψ » $= 135°$, « c » is smaller than « a » by 40 %. It results therefore that a considerable quantity of solid particles (up to 40 % of the filtrated suspension is not delivered on the wire when the angle of inclination $> 90°$.

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For the evaluation of this phenomenon, another value « Ky » — coefficient of collection — is introduced to indicate the part of the solid phase which is retained by the filtering wire.

$$Ky = \frac{c}{a} = \frac{G}{aV} \qquad (2\text{-}21)$$

where

Ky - is the coefficient of collection;
G - is the weight of dried layer delivered on 1 cm^2 of surface of the wire.

It is obvious that if the filter would retain all the particles of the solid phase then « c » would be ⩾ « a » and $Ky \geqslant 1$. Therefore, in consideration to the fact that not all the solid phase is delivered on the wire, then the weight of the asbestos-cement layer delivered on the wire should be calculated using formula (2-2) when the volume of filtrated material and concentration of the suspension are known factors:

$$G = K_y aV$$

These particularities of the filtration of asbestos-cement suspension confirm the impossibility of a direct application of the known equations of filtration for the calculation of the productivity of the sieve cylinders. Table 2 gives data on the quantity of solid particles carried away by the filtrated material. Experiments carried out on the equipment with cylindrical filter (see fig. 12) allowed to determine more exactly the time during which the solid particles are carried away. This time varies, with suspensions of different compositions, from 0,9 to 1,2 seconds. It was noted that after 1,2 seconds, the water in the collectors was clean and did not contain solid particles.

It has also been established by experimental work, that during the process of formation of elementary asbestos-cement layers by filtration, while the layer increases in weight, qualitative changes occur simultaneously and in particular as filtration is progressing, the size of the pores of the delivered layer changes. Besides when the angle of inclination of the wire is greater than 90° porosity decreases. It is very important for the technology to establish in more detail the differences that characterise layers with different porosity, and it is for this purpose that specific weight of asbestos-cement layers of different thicknesses and obtained with different times of filtration, was determined (see fig. 15).

The total content of CaO and MgO in the elementary layer was established by chemical analysis. The cement used in the suspension contained 62,2 CaO and 3,10% MgO and asbestos 0,4% CaO and 40% MgO. On the basis of the above the ratio asbestos-cement in the layer was calculated and the obtained data is given in table 3.

The data referred in table 3 shows why average specific resistance and compactness of the layer increases while pressure remains constant. The cause is the increasing saturation of the layer with cement. As the figures in table 3 show, the ratio asbestos-cement in the layer changes from 0,32 to 0,20 as the thickness of the layer increases. Graph, fig. 15 confirms the conclusion that porosity of the layer decreases as time of filtration increases.

The change in structure of the elementary layer during the process of filtration is the next subject investigated as it was necessary to know the reasons for the purpose of controlling the formation of the layer on the sieve cylinder; the reasons for the partial delivery of asbestos-cement particles will be explained.

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