International Fertilizer Industry Association

ISMA* Technical Conference

Edinburgh, United Kingdom
14-16 September 1965

**In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).*

International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

HIGH YIELD FILTER FOR HIGHLY CONCENTRATED PHOSPHORIC ACID

By A.R. Macq (Union Chimique - Chemische Bedrijven, Belgium) and C. Heudier (Péchiney-Saint-Gobain, France).

The general trend in phosphoric acid production has long been aimed at the direct production of highly concentrated acid. The object is to reduce the size of the concentration plant and the heat consumption for any given level of P2O5 production. The development of the single, non-compartmented reactor has made it possible to manufacture phosphoric acid of 36% P2O5 or more and to achieve good yields by means of the classic gypsum process, using various phosphate rocks.

Armed with this industrial experience and faced with the usual well known difficulties with filters, we decided to define the criteria for the ideal filter. This was the subject of a paper presented to the ISMA Technical Conference in Wiesbaden in 1961 (1). It constituted a kind of appeal to constructors, encouraging them to improve their equipment.

Furthermore, during the last few years, the very rapid increase in the unit capacity of phosphoric acid plants has only made the difficulties more acute. Whilst occupied with this problem, we conceived the idea of constructing a continuous, turning table filter with a horizontal moving belt.

What are the advantages governing this choice?

- The table filter is mechanically simple and requires comparatively little maintenance.

- The absence of pans, and thus of any tilting device, permits a fast speed of rotation.

- The moving belt fulfills two purposes:

  1). It acts as an external side wall enclosing the area of filtration.

  2). By disengaging it from the table, total evacuation of the gypsum and complete washing of the cloth can be obtained. The fixed side wall not only prevented washing but obliged one to leave a slight thickness of gypsum on the cloth (2) (3).

- The extrapolation of such a piece of equipment is easy.

How far does this filter fulfill the criteria set forth in the paper mentioned above?

Photograph No. 1 and figures 2 and 3 show how the problems have been resolved. In particular:

- The suction box is circular and compact. It is attached to the table by means of a flexible coupling. The vacuum of 500 mm of mercury is easily obtained, and even exceeded.

- The speed of rotation is high (one revolution in less than $1\frac{1}{2}$ minutes). Under these conditions, with a standard thickness of 35 mm, a considerable rate of production is achieved (9 tons of P_2O_5/m^2 x 24 hours).

- The continuous filtration surface permits as many washing stages as are required by the desired concentration, and thus maximum utilisation can be achieved.

- The large number of cells under the filter cloth and the possibility of easily adjusting the mobile partitions between the sections of the suction box in a very short time permit a very strict separation of the filtrate, whatever the product to be filtered.

- The rapid liquid flow, encouraged by the special design of the filtrate receiver and the pipes connecting with the suction box minimises the risk of mixing the filtrates and diluting the product acid, even at high speeds of rotation.

- With the exception of one part of the apparatus which channels off the acid, the filter is entirely constructed of 316 L stainless steel and nobler alloys, thus ensuring a long working life and reduced maintenance.

- The disengagement of the belt, freeing the table, enables the dry gypsum to be extracted by various dynamic or static mechanical means, and permits the washing of the cloth.

- A sector for drying the cloth has been designed to eliminate the remaining water.

In conclusion, the desired criteria have been fulfilled as faithfully as could be wished.

What was the first installation of this kind, and what are the industrial results?

After a period of numerous trials on the different constituent parts of the filter, a working prototype was constructed, with the following characteristics:

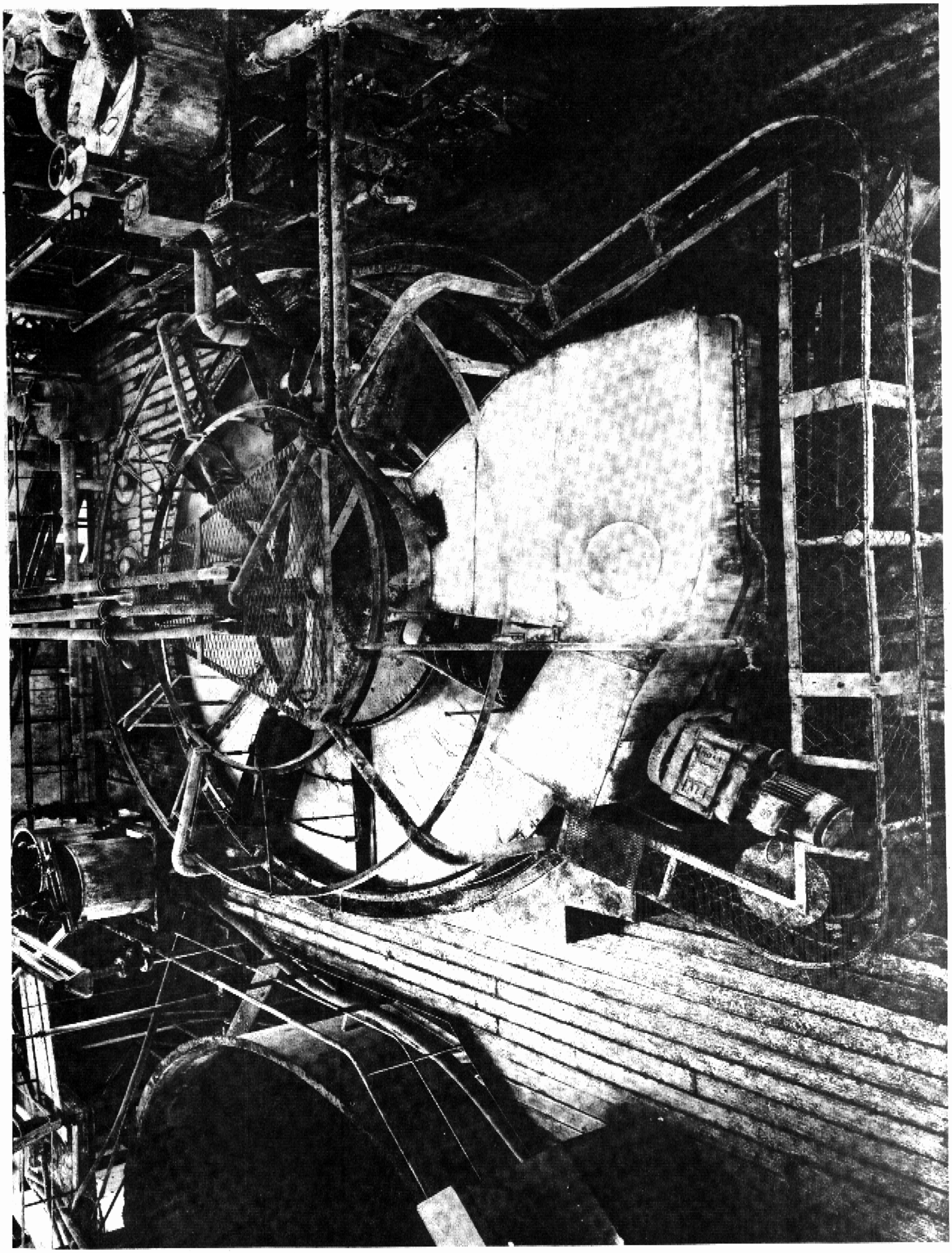
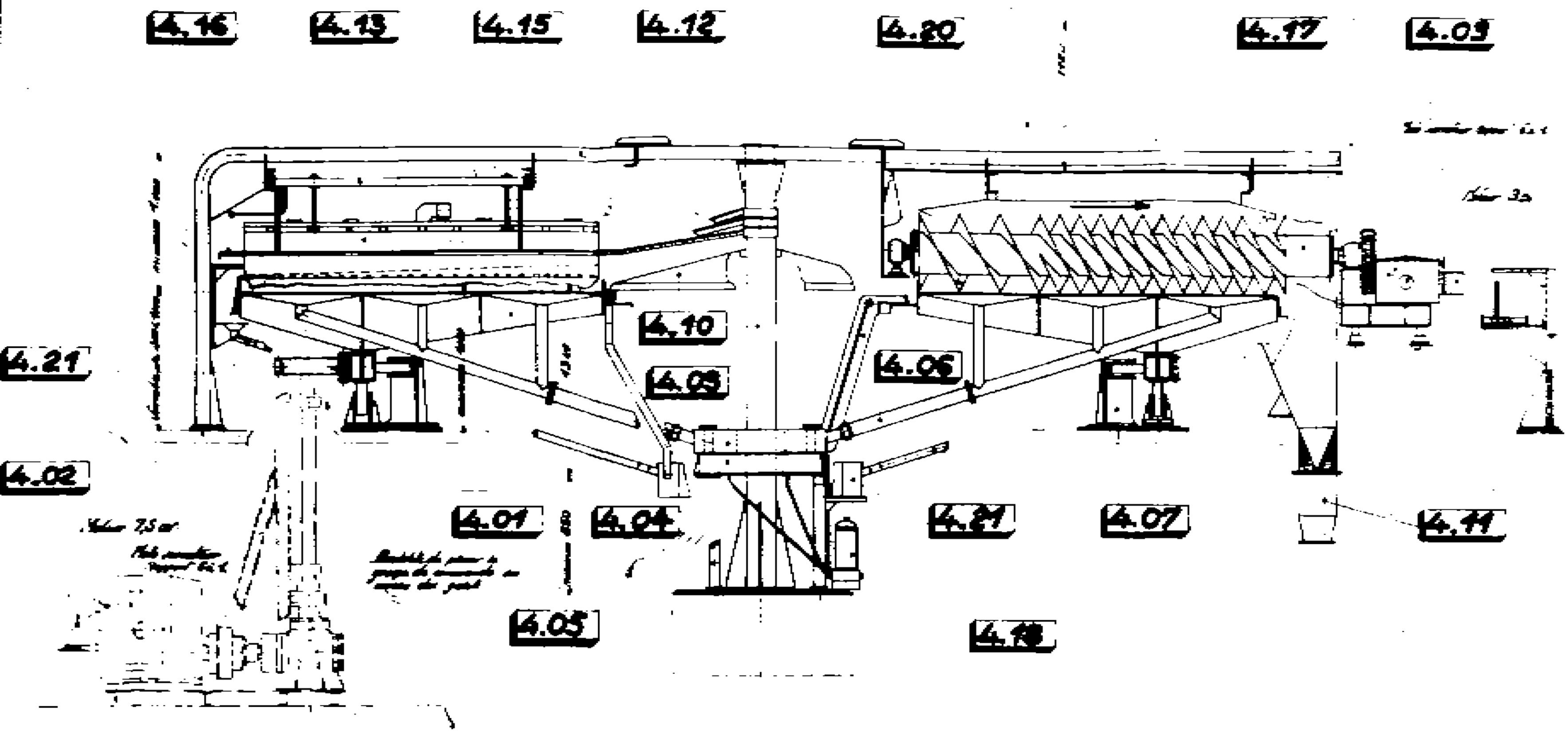


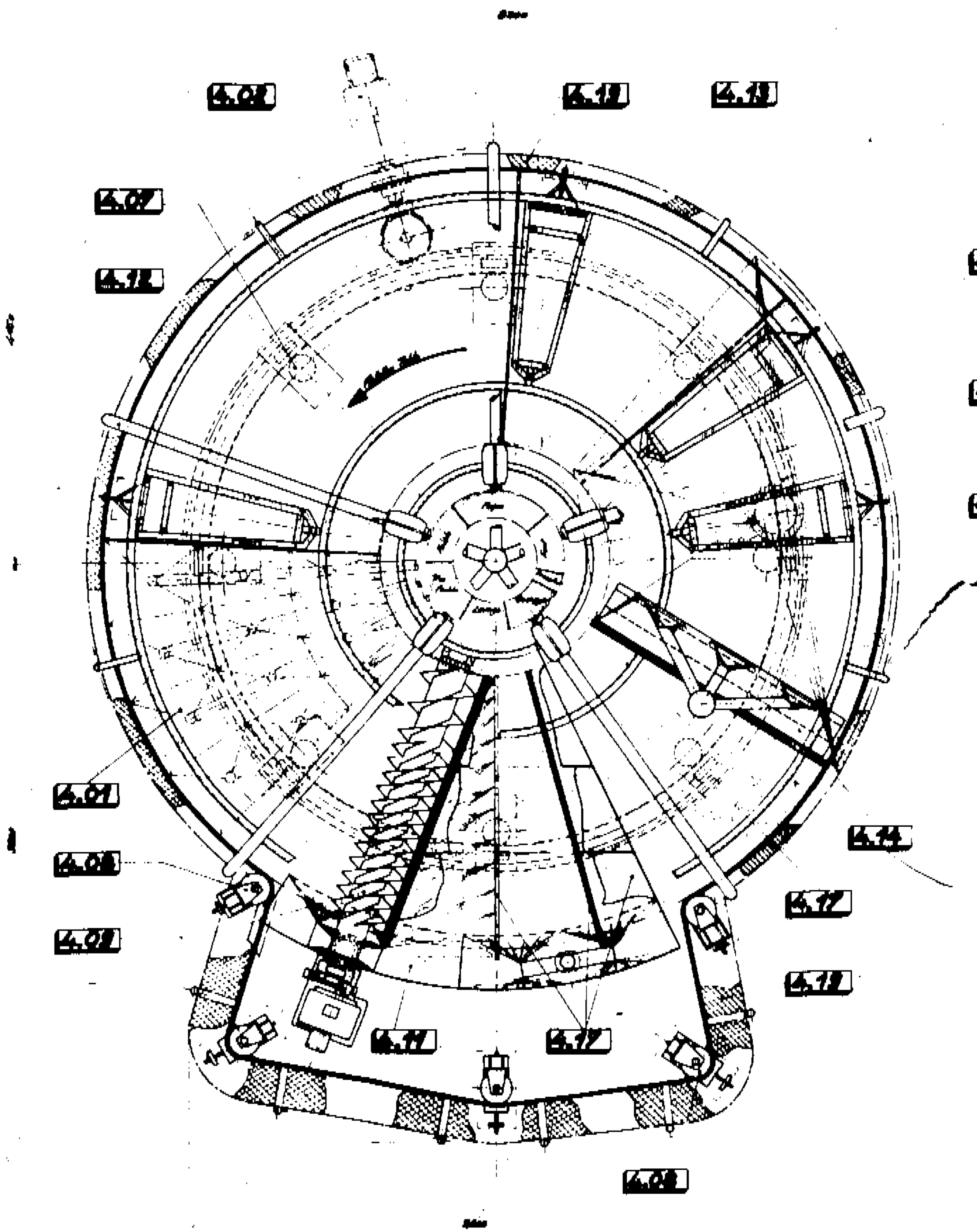
Figure 1 : "UCEGO" turning table filter for highly concentrated phosphoric acid.

SCHEMA_2



4.16
4.13
4.15
4.12
4.20
4.17
4.03
4.10
4.09
4.06
4.19
4.21
4.02
4.01
4.04
4.24
4.07
4.11
4.05
4.18

SCHEMA_3



- useful surface area 7.3 m^2

- total surface area 10 m^2

It was installed 5m above the filtrate extraction pumps, in a production plant, in parallel with other classic filters. Comparability is therefore indisputable.

Since putting it into service (November, 1963), it has functioned normally, without interruption, fed by the slurry prepared in a single tank reactor.

Operational results are as follows:

No.	Phosphate rock	Concentration of product acid, % P205	Production in 22 hours (1), tons P205	Specific production in tons P205/m^2 x 24 hours	Period recorded
1	Moroccan 75, unground	27	68	10.2	1 month
2	Togo, unground	31	66	9.85	2 months
3	Togo, unground	33	58	8.65	4 months
4	Togo, unground	35	47	7	5 months

(1) In accordance with the mode of operation of the other filters in the plant.

For the sake of comparison, the following are results obtained simultaneously with conventional filters:

a). on a travelling pan filter with a useful surface area of 12 m^2:

- with slurry No. 1, a specific production of 5.9 tons P205/m^2 x 24 hours.

- with slurry No. 4, a specific production of 4.3 tons P205/m^2 x 24 hours.

This filter, like the prototype turning table filter, causes only a slight dilution of the phosphoric acid contained in the slurry: the P205 content was reduced

by 0.4% for a product acid of 35% P205

by 0.25% " " " " " 26.5% "

b). on a circular tilting pan filter with a useful surface area of 12 m^2

- with slurry No. 1, a specific production of 5.3 tons

P_2O_5/m^2 x 24 hours, but with a reduction of 2.3% in the P_2O_5 content

- with slurry No. 4, industrial operation was not possible, since the extracted acid was diluted to 32% P_2O_5.

These specific rates of production were obtained with unground phosphates. They would be 20 to 50% higher if ground phosphates were used, depending on the concentration of the acid or the nature of the phosphate. This is confirmed by industrial results obtained in certain of our plants. The use of ground phosphate would, moreover, permit a higher concentration of the product acid than 35% P_2O_5.

What other plants have been installed?

After this conclusive experiment, a filter with a useful surface area of 55 m^2 is to be installed in a new plant in the same factory and will be put into service early in 1966. Other units are in the course of construction for three outside firms:

- a filter with a filter area of 30 m^2

- two filters with a filter area of 35 m^2

The designed standard range covers the following dimensions:

Filter No.	filter surface area: m^2	Observations
1	7.3	Already in service
2	13	
3	20	
4	30	under construction
5	35	" "
6	45	
7	55	" "
8	75	
9	100	

Are other uses possible?

This filter was specially constructed for the difficult case of phosphoric acid. It would be just as suitable for the semi-hydrate or anhydrite processes as for the gypsum process. Obviously, it may also be used for the filtration of other products. It offers the advantage of a short retention time for the solid material on the table.

The authors wish to point out that the experimental study and industrial operation of the filter were decided upon and carried out under the auspices of the committee of the Technical Agreement in the field of phosphoric acid, set up in 1943 between the Belgian company, Union Chimique - Chemische Bedrijven, and the French company, Péchiney-Saint-Gobain. Numerous scientists and engineers in the two companies collaborated in this project.

In view of the identity of the parent companies, the name of the filter is "UCEGO".

On special request to either of the two firms, the prototype can be seen working at the factory of Péchiney-Saint-Gobain Engrais, at Grand-Quevilly, Seine Maritime, France (near Rouen), prior to the start-up of the 55m^2 filter in the same factory.

The filter is patented in more than twenty countries.

References

1). B. Bigot and J.F. Gielly, The filtration of phosphoric acid liquor: different types of filters to deal with the increased concentration of acid produced. ISMA Technical Conference, Wiesbaden, 1961. ref. LE/61/52.

2). Wm.C. Weber and G.J. Pratt, Chemistry and Technology of Fertilizers, Edited by V. Sauchelli, ACS, 1960 - pp.217 - 218.

3). Wm.C. Weber and F.W. Edwards, Proceedings No. 67, The Fertiliser Society, 23rd March, 1961, p.21.

Another point relating to maintenance which considerably perturbs our visitors is the behaviour of the rubber belt. I should like to emphasise that this belt does no work: its purpose is simply to maintain the water-tightness of the table for the slurry and the wash liquors. It does not drive the filter. Thus the tension on this belt is relatively weak, and there is no reason for there to be any pronounced wear. Again, I can tell you that the belt on the filter which has been working for nearly two years still appears as new. I think it will last for several more years.

MR. W. R. SCURR (Bosveld Kunsmis, South Africa) : The authors have demonstrated that the table filter can achieve a capacity approaching twice that of a circular tilting pan filter working on identical slurries. This is a startling increase for which it is difficult to see a fundamental reason. Perhaps a good deal is due to having no areas of dry cake as in the case of a correctly operated tilting pan filter; but does not the absence of separate pans result in mixing of wash liquors before entering the cake, thereby making true "plug flow" of the successive washes impossible ?

It would be interesting to know how the two types of filter compare in respect of washing efficiency and ultimate dryness of the gypsum.

MR. ROUBINET : The reason why our filter offers such an increased capacity is not, in fact, a question of miracles. As was demonstrated by Messrs. Bigot and Gielly, it is simply a question of the physical law of filtration. The rate of filtration of a filter cake is practically proportional to its thickness - at least for the usual cake thicknesses, for in this case we may, in practice, neglect experience gained in relation to the influence of the filter cloth. Thus, if a filter can revolve quickly for a given production, the quicker it turns the less thick the cake becomes, and thus the more rapid will be the speed of filtration or, in other words, the more one will be able to produce on the same filter.

Moreover, it is certain that the use of a filter with a continuous filtration surface offers a certain advantage. As you remark, to achieve a good wash one must feed in a wash liquor only when the preceding liquor has completely disappeared from the surface of the cake. This means that with a pan filter of whatever type one is obliged to have one entirely dry pan before each wash. In the normal case of a three-stage wash, you therefore have three dry pans. In the case of the continuous surface filter, again of whatever type, the wash liquors are held on the filter between two dams. It is always possible to place the up-stream dam only a few centimetres, say, before the feed-in of the following wash. Thus we can say that we gain about two thirds of a pan for each wash. In the case of normal filters with three washes, this implies a saving of $1\frac{1}{2}$ - 2 pans, i.e. about 10% of the filtration area.

As far as "plug flow" is concerned, which is the effect we seek to obtain, I do not see why it should be different with our filter, in view of the fact that we contain the liquid between two dams.

Finally, with regard to the washing efficiency and the dryness of the gypsum cake at the point of discharge, I can assure you that, in order to obtain valid, comparable results for the three filters which we have used, we have tried to have not only the same slurry but also the same results, i.e. the same soluble P205 losses and the same ultimate dryness of the cake. The results are thus of the same order of magnitude for all three filters. The soluble P205 losses essentially depend, whatever the process, on the concentration at which one is working and on the phosphate used. As far as the phosphates mentioned in the text are concerned, i.e. mainly Togo, together with Moroccan Khouribga, the washing efficiencies for all three filters are higher than 99% - especially with Togo phosphate which produces a slurry which filters and washes well. With regard to the water content of our gypsum cake at the end of the cycle, it was about 25% with Togo phosphate and about 30% with Moroccan phosphate.

MR. F. W. EDWARDS (Dorr-Oliver, U.K.) : This paper describes an interesting development in the specialised field of filters for phosphoric acid - gypsum separation. I believe, however, that many people like myself will have a number of reservations or questions about the real advantages this machine will offer, particularly in the larger sizes.

I understand from your last reply, Mr. Roubinet, that P_2O_5 losses during washing were the same for all three tests run; but in this case I should be interested if you could tell us the belt speed of the travelling pan filter and why you did not try to run it faster.

MR. ROUBINET : The speed of the travelling pan filter was approximately 4.2 m/min., which is relatively slow. I should mention, however, that this speed has been considerably increased in comparison with the original speed of the filter, which was about 3.2m/min. In any case, a simple calculation would show us that to achieve the same result as with the filter which we are presenting, the travelling pan filter would have to have a speed of about 9 m/min. This figure is high, when one considers the wear on the belt, and here we place our finger on the great difficulty of extrapolating this kind of filter. For reasons of mechanical behaviour and balance, it is difficult to extrapolate the pans in width. Thus, one extrapolates the surface area by increasing the length of the containers; but then one must increase the speed of the filter in order to obtain the same result, and one rapidly arrives at an impossible situation, at least with the presently available materials for the rubber belts.

MR. EDWARDS : The only filter of the type you are now presenting, which is in actual operation, is a unit with 7.3 m^2 active area. I would estimate the diameter of such a unit to be approximately 3.65 m (12 ft). We are told that the speed of rotation is one revolution in less than 1½ mins. If one revolution was in fact made in 1½ mins., the peripheral speed of the filter would be about 8m/min. (26 ft./min.). This may not seem at all unreasonable, and is in fact comparable with standard horizontal filters. However, when one considers the 35 m^2 and 55 m^2 units under construction, the peripheral speed would have to increase to about 17 m/min. and 21 m/min. respectively in order to maintain 1½ mins. per revolution; and there is even a 100 m^2 unit listed in the designed standard range. Is it therefore proposed to maintain the same cycle time for all filters in the standard range ? If not, how much will the capacity per unit area fall off with increase of filter size ?

MR. ROUBINET : The figures quoted by Mr. Edwards show his thorough knowledge of the question. He is right: the peripheral speed of the present filter is about 8 m/min.; that of the 35 m^2 is about 17 m/min.; and that of the 55 m^2 filter is a little more than Mr. Edwards' estimate - about 23 m/min. But we do not see why this peripheral speed should give trouble. With a circular tilting pan filter, the pan tilting system, which is mechanical, produces shocks and vibrations beyond a certain peripheral speed. In the case of our filter we have no fear of this kind of trouble, since there is no discontinuity in the rotation.

As far as the behaviour of the belt is concerned, belt speeds would thus be of the order of 8 m/min, 17 m/min., and 23 m/min. This belt, as I said previously, does no work; there is no friction between the belt and the edge of the filter. There again, therefore, there is no reason for mechanical trouble. Besides, conveyor belts normally used for chemical products are in considerably greater tension than the belt on our filter and also move at higher speeds.

I think, in fact, that the real problem with regard to the speed of filtration relates to the liquid flow. The rate of liquid flow over a surface in a given time remains constant, but if the filter diameter is increased, the distance to be covered increases and the time in which to cover it remains the same. Here, therefore, there is a contradiction. We have solved this problem by increasing the number of circular sectors in our filter and by increasing the number of outlets for each circular sector, in order to retain approximately the same distances to be covered. Thus, with the same distance to be covered in the same time by a liquid at the same speed, one ought to be able to maintain approximately the same speed of rotation for the same result. In any case, I think that very soon - within about three months - we shall, I hope, have the confirmation of all this at our Rouen Factory with the 55 m^2 filter.

MR. EDWARDS : With such large units - of, say, 30 m^2 and more - and assuming they operate at the high speeds mentioned - have the designers satisfied themselves -

a) that satisfactory cell drainage can still be realised via the multiplicity of pipes shown in the diagrams, whilst still preserving the sharp separation of the filtrates ?

b) that satisfactory cloth washing can be achieved and only low dilution of the product filtrate realised ?

c) that scaling is no greater problem than with other filters and can be just as easily removed by washing ?

d) that belt tensioning, even though it may be small, and any wear rate on any part of the filter will be no problem ?

MR. ROUBINET : With regard to your first question, as I have said previously, we increase the number of radial sectors and the number of outlets. As far as drainage is concerned, I think, therefore, that we solve the problem in this way.

With regard to sharp separation of the filtrates, I think that the increase in the number of drainage sectors answers this question also.

With regard to cloth washing, we shall have the same time in which to wash them, whatever the size of the filter. We merely have to provide the number of nozzles corresponding to the diameter of the filter.

The problem of filter scaling, and, in particular, scaling in the vacuum boxes concerned us for a long time with the conventional filters, until we developed an efficient system of daily washing. Since then, we have had no more difficulty with this problem of scaling. With the new filter in service at Rouen, we have had no more difficulty than with the other filters. I cannot see why we should have more difficulty than with a large conventional filter, of the tilting pan type for example, in which the size of the vacuum boxes would probably not be very different.

Finally, with regard to belt wear as a result of tensioning, I do not think we are considering any substantial increase in the tension. Nevertheless, we have perhaps had problems with regard to the large filters; but the price of the rubber belt - a conveyor type belt, i.e. a rubber belt with a fabric armature - is in itself relatively low in relation to the price of the filter. If we have to replace the belt every three or four years, I do not think this will greatly increase the budget. Moreover, the rollers around which the belt rolls are very simple mechanical parts, the shape of which is largely designed to avoid just this problem of wear occurring at high speeds.

MR. EDWARDS : With regard to the question of gypsum discharge, what percentage of the gypsum is expected to be removed by the scroll ? Where dry gypsum is required, has no problem been found in water used for cloth washing penetrating into the area where the dry gypsum is being taken off ? Presumably you rely on a rubber dam to effect this separation on the table and on some form of split hopper to keep the gypsum cake and gypsum slurry from cloth washing separate.

MR. ROUBINET : The question of dry gypsum discharge is, indeed, one of the problems with which we are concerned. To avoid tearing the cloths we are obliged to place the lower edge of the scroll about 2mm above the cloths. With the wear which will inevitably occur on the scroll, one can thus easily have 3mm of gypsum remaining on the cloth after the extraction of the dry gypsum. Obviously, if we work with large thicknesses of gypsum, contrary to the principle of our filter but in conformity with other conventional filters, the amount remaining will be relatively small - about 2 - 3%. In the case of our filter, we try to work with small thicknesses - about 30 mm - which means that about 10% of the gypsum remains on the table. This 10% is evacuated by water, and hence we have the problem of preventing the water from entering the dry gypsum hopper. This problem is overcome by dams. The second problem is that when absolutely dry discharge is required, i.e. the total absence of gypsum in the factory effluents, we are obliged to recycle this gypsum laden water on to the filter as wash liquor. This runs the risk of slightly decreasing the production capacity of the filter.

MR. EDWARDS : If you can build a filter of this type with a very large diameter with a scroll set no more than 2 mm. above the table, you have achieved quite a feat of engineering.

In conclusion, I should like to congratulate you on your paper and thank you for your very explicit answers. But I would also like to suggest that your statement at the top of page 2 that "the extrapolation of such a piece of equipment is easy" may prove to be rather an optimistic over-simplification.

MR. ROUBINET : I think that you are right when you say that with large filters there is a risk that the distance between the scroll and the table may be a little more than 2 mm; this is a question of experience, but I mentioned previously that we can use other extraction systems which we are already studying. With these systems, I think we shall be able to maintain the distance of 2 mm.

Perhaps we did not express ourselves very well when we said we thought extrapolation was easy with this filter. In fact, no extrapolation is ever easy, but we think it is far easier to overcome the problems arising from extrapolation with our type of filter than with any other type.

MR. R. BAUWENS (Ets. Kuhlmann, France) : I should like to put a question of a theoretical nature. You say that the specific production of your filters is larger when you use ground phosphates. Is this observation supported by a theoretical reason? I should like to ask the same question with regard to the concentration of the solutions filtered.

MR. ROUBINET : The effect of grinding the phosphate rock is a question we have specially studied with tests. Our tests do indeed show that when using ground phosphate rock the speed of filtration of the slurry is greater. It is no less certain that if one wishes to obtain concentrated solutions of phosphoric acid it is necessary to grind the phosphate rock, again for the same reason, because one obtains an increase in the speed of filtration, the wash grades and the reaction capacity. In any case, there are phosphates which we are obliged to grind.

MR. BAUWENS : If I understand you, this is a reason for what you have observed, but a theoretical explanation escapes you.

MR. ROUBINET : For the moment, yes. A more homogeneous medium is required ...

MR. BAUWENS : I ask you that, because just now someone reported having found exactly the opposite. This was why I wanted to know if there is a reason; and perhaps it concerns the process of manufacture in the reactor.

MR. ROUBINET : We have been carrying out tests at Péchiney St. Gobain for more than 10 years now, and we have always had these results; and we have also used grinding in certain of our factories. We do not study questions of plant equipment at our Rouen factory, but we have used ground phosphate in other works, and there has always been an increase in the yield and in the filtration capacity.

MR. O. JENSEN (A/S Dansk Svovlsyre- og Superphosphat Fabrik, Denmark) : When you say you have a production of 7 tons $P_2O_5/m^2/24$ hrs., what is the content of water soluble P_2O_5 in the gypsum when working with Togo phosphate and with a concentration of 36% P_2O_5 ?

MR. ROUBINET : The soluble P205 loss was about 1% in relation to the phosphate rock used. The P205 content of the dry gypsum was about 0.25%.

MR. JENSEN : How often to you change the filter cloths ?

MR. ROUBINET : We have 15 cloths on the filter in operation. We shall have 18 cloths on the 55 m^2 filter. With fairly highly concentrated acid - between 33 and 35% P2O5 - such as we are currently using, we change one cloth per day. I should point out that as the filter is in contact, one should speak of the use of cloths as a function of the amount of filtered gypsum or phosphoric acid. In fact, if one makes a comparison with other filters of more or less large sizes, one sees that the use of cloths is roughly the same. We hope to increase the life of these cloths by using wash water at high pressure, but we do not yet have sufficient experience. I believe there are a certain number of companies which already have this experience.

MR. D. J. COATES (Chemical Construction (G.B.) Ltd., U.K.) Further to the comparisons given in pages 6 and 7 concerning the relative capacities of filters, I wonder if the authors could give an indication of at least the orders of magnitude of the total installed capital costs for the three different filter types.

MR. ROUBINET : A travelling pan filter requires much more space and should therefore be more costly to install. Comparing our filter with a tilting pan filter, the costs for given diameters should be roughly of the same order of magnitude. But for given rates of production, we have smaller diameters. I think, therefore, that our filter must be a little cheaper to install.

MR. R. NORDENGREN (A/B Förenade Superfosfatfabriker, Sweden) : If I understand correctly, you change one filter cloth each day and you have 15 cloths on your table. This implies a life of 15 days for each filter cloth. Why do you have to change the cloths - because they are blinded, or because they are holed ?

MR. ROUBINET : It is because they are blinded, because we have a blockage of circulation within the cloth. This is why we hope that high pressure washing will increase the life of the cloths.

DR. T. K. VAHERVUORI (Rikkihappo Oy, Finland) : On page 7, you say that the results presented were obtained with unground phosphate. You also stated that by using ground phosphate the rate of production will increase. Have you made any investigation with ground phosphate and, if so, what was its fineness ? What is the concentration of the product acid, when ground phosphate is used, and is there any correlation between the fineness of the rock and the strength of the acid ? Have you made any tests with phosphates other than those from Morocco and Togo, e.g. Florida or Kola phosphates ? If so, what was your experience ?

MR. ROUBINET : With regard to investigation of ground phosphates, much work has been carried out for many years. We have tried to establish optimum fineness, and this is very difficult, for slurry qualities vary continuously with fineness. What we can say is that with phosphates such as those from Morocco, as long as the required acid concentration was 30% or less, an economic calculation easily shows that the increase in yield or the gain in capital utilisation which can be obtained, do not compensate for the additional expense of grinding. As I said just now, this is why we do not grind our phosphate rock at our Rouen factory. On the other hand, even with phosphates like those from Morocco, one is obliged to grind if one wishes to obtain acid concentrations of more than 32%. We normally grind to about 70% passing 200 mesh. As far as phosphates other than Morocco are concerned, we have used Togo and Senegal phosphates, and in plants which we have sold overseas we have used Florida and Kola phosphates. With regard to the results of our experience one can say that Kola phosphate requires no additional grinding, as it is already finely ground. On the other hand, it is more difficult to attack. As far as Florida phosphate is concerned, it is in practice necessary to grind it, at least for most of the current grades.

MR. W. C. WEBER (Dorr-Oliver, U.S.A.) : I should like to point out that in the light of present practice and experience in the U.S.A. these capacities reported in this paper are not unusual. As you know, almost all new plants nowadays are very large. A 500 tons P_2O_5 per day phosphoric acid plant is only average now. A 300 ton/day plant is considered small. Plants with capacities of 600-700 t.p.d. are being built, and plants of 1,000 t.p.d. are being proposed with a single reactor and a single filter. Plants now operating and under construction are based on about 7 tons P_2O_5/m^2. The largest filters now being used are about 970 sq. ft., but some are under construction with 1500 sq. ft. (net area).

MR. ROUBINET : With what phosphates do you obtain a figure of 7 t. $P205/m^2$?

MR. WEBER : This figure relates to low-grade Florida rock, 66-68 BPL. Normally, this is considered a more difficult rock, giving lower filtration rates than either Togo or Morocco rocks.

MR. ROUBINET : I do not think this is our experience. We have found very often in our tests that Florida phosphates, particularly the low grades, are better than Morrocan for concentrations around 31% P205. Is this not your opinion ?

MR. WEBER : No : we usually rate filters about 20% higher on Casablanca Morocco rock than on a normal Florida phosphoric acid grade rock. We also found that Togo may be even better than Morocco. But to get these filtration capacities, the tilting pan type filters, which are used almost exclusively - either the Eimco or the Prayon type - are operated at rates of 1 revolution/ 3 mins. to 1 rev./5 mins. And this applies even to the filters of 55-60 ft. diameter.

MR. ROUBINET : These are precisely the figures I had for rotation speed. With regard to Togo phosphate, I agree with you entirely concerning its filtration capacity, which is distinctly better than that of Moroccan phosphate. Unfortunately, I cannot say that I agree with you as to the comparative results from Florida and Moroccan phosphates. I think this depends very much on the mines: there are many mines in Florida which have different results, and each case must be studied individually. I do not think one can make an *a priori* comparison of plant capacity like that without having carried out laboratory tests.

MR. WEBER : I don't think the grade of Florida rock which I am referring to - 66/68 BPL - is known or used in Europe. If we were talking about 74 BPL Florida rock, there would probably be very little difference from Moroccan rock. But with these very low-grade rocks, containing relatively high levels of iron and aluminium - 2½ - 3½% R_2O_3 - you have a very difficult rock for phosphoric acid manufacture.