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REMARKS ON THE RUNNING OF A SULFURIC ACID PLANT WITH B.A.S.F. FURNACE AND INTENSIVE SYSTEM OF ORDINARY STEEL-TOWERS

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ANTECEDENTS.-

The factory of Pontevedra which was started at the beginning of July 1954 after a period of construction of a little over two years was inspired by the purpose of combining the then rather new technique of calcination of iron pyrites in a turbulent bed with the intensive system of manufacturing sulfuric acid in ordinary steel towers. Although both techniques employed in different plants were well known, the above mentioned factory was the first one - and at the present moment is still the only one - to associate both procedures and to employ B.A.S.F. furnaces in our country.

In addition to its purpose as a production unit, the plant was also a test installation, the performance of which, in respect of flexibility of operation, economy of power usage and maintenance, will affect other developments in prospect. It was particularly designed to compare the performance of the turbulent bed furnace with the multi-hearth type of furnace used so frequently in our country owing to factors connected with distribution of fertilisers and which are of a size to render steam generation uneconomic. It was for this reason that it was decided to instal a B.A.S.F. furnace without steam production and to examine the behaviour of the furnace as well as of the steel tower system.

FEATURES OF THE PLANT.-

Leaving aside all the accessory elements the plant for the manufacture of sulfuric acid is as follows:-

One RASCHKA type rectangular section turbulent bed calcinating furnace,- B.A.S.F. system, with a capacity of 40/50 tons of iron pyrites and volumetric feed by a rotating disc feeder. Cooling is realised partially in the furnace itself by means of a flat chamber and a cooling plate, with a total surface of about 7 m^2 through which low pressure steam or water are circulating. The cooling of the gases is completed in the second body or boiler, which is also of a rectangular section provided with 6 groups of pipe coils for the circulation of water and steam, with a total surface of 90 m^2.

Air is supplied by means of a variable speed compressor and is mainly distributed under the grate. A by-pass permits an air bleed up to the top of the turbulent chamber as secondary air to be regulated by means of a valve.

One SZCHOKE system electrostatic dust precipitator with five chambers provided with a device for the automatic vibration of electrodes and fed with rectified current by means of rotary rectifiers. The plant operates with groups of chambers at a different or at the same voltage equally well.

One 11 m. high volvic filled Glover Tower with an external diameter of 4 m.

One 11 m. high volvic tower filled with Raschig rings, with an external diameter of 4 m.

Four ordinary steel towers made of 7 mm. thick sheets, with a diameter of 4,80 m. and a height of 10m. The towers are partially filled with Raschig rings up to the following heights:-

Tower I.	7,32 m.
Towers II and III.	1.00 m.
Tower IV.	2,00 m.

They lack an internal lining except for No.I, the lower part of which is protected up to the height of the grating. The acid distribution is effected by means of atomisers and pulverisers. The former partly operate at 3.000 r. p.m. and partly at 1,500 r.p.m.

Two Gay-Lussac towers with a volvic grating filled with Raschig rings, with an external diameter of 3,20 m. and a height of 12 m.

This plant is completed by acid circulating pumps, fans, circulation tanks, refrigerants etc. whose description we leave out as it is already known from other similar units.

Production. Although production has varied since at different times from 33 to 45 tons/day of iron pyrites containing 48% of S have been burnt, we mention as an example a production of 47,33 tons/H_2SO_4/day which has been used over a long period. Acid production in the different sections of the plant has averaged as follows:

	%	tons H_2SO_4	Work Intensity Kgs/m^3
Glover	26,8	12,7	115
Volvic Tower	18,7	8.8	74
Reactor I	43,6	20,7	115
Reactor II	8.7	4.2	23
Reactor III	1,5	0,7	4
Reactor IV	0,7	0.4	2

Excluding the capacity of the Glover as the normal practice, the working intensity of the chamber system amounts to 56,3 kilo/m^3.

The average consumption under these operating conditions is as follows:-

Energy: Furnace and Electrostatic precipitator, 11,8 KWH/ton acid
Sulfuric plant, 20,7 KWH/ton acid.
Water: Furnace, 45 m3/ton acid.
Sulfuric plant, 25 m3/ton acid.
HNO_3 (100%), 7-8 Kgs/ton H_2SO_4 (100%)

OPERATING CONDITIONS.

The operation of this factory from its beginning until the present moment can be divided into two different stages. The running of the furnace with a water cooling system forms part of the first stage whilst the second is characterised by the use of low pressure steam which at the present moment is not used, but is condensed in order to return it to the cycle, cooling being effected with hot water (94-97°C) instead of 15°C water used at the beginning. Although both stages are quite different from each other in their operation, they have given rise to identical results from the operation of the steel tower system, not withstanding the different number of occasions on which the furnace itself has been re-started in the two cases.

FIRST STAGE.

It can be defined as a test period mainly devoted to studying the most favourable conditions of the assembly although special attention was paid to the furnace and the purification of gases since the special features of our plant created problems of its own.

At that time there were only two RASCHKA type furnaces in existence running without a steam boiler, and even these were not strictly comparable.

This period, which was characterised by frequent failures and restarts, constituted an interesting experience concerning the behaviour of the plant for the manufacture of sulfuric acid which in spite of all these irregularities operated very well, thus confirming the stability of the system and its high conversion output. During this stage, which exceeded six months, the running conditions were changed in accordance with the experience gained. The information is summarised as follows:

Iron Pyrites. Although at the present moment Rio Tinto iron pyrites with an average content of 48% S and a particle size lower than 6 mm are utilised, pyrites of rather larger particle size was used at the beginning. A test made with iron pyrites up to 12 mm confirmed the feasibility of employing bigger sized grains without adversely affecting combustion. Nevertheless, frequent obstructions of the dosing apparatus were caused by purely mechanical reasons exclusively connected with the dosing device which by affecting the feeding regularity modified the thermic range of the furnace with dangerous fluctuations of temperature. We therefore do not reject the idea that larger iron pyrites can be employed, although this, of course, would imply the study of adequate feeding devices and the need for handling iron pyrites which as in our case, decrepitate easily.

As to the moisture contents it has been possible to work with iron pyrites up to 7% although the best results corresponded to those of a size not higher than 6 mm with a moisture not higher than 3.5%. For the use of iron pyrites with 7% moisture it was necessary to adapt to the feeding hopper a vibrator avoiding compacting of the ore. A pre-drying device installed at the beginning at the same hopper did not give any satisfactory results.

The particle size of this pyrites is extremely variable especially in respect of the fines content which in some cases exceeded 63% of grains smaller than 0,5 mm although as a rule this proportion varies between 10-20%. The following can be considered as an average type:

Microns			
+ 6000	6.3	+ 400	9,7
+ 4000	10,1	+ 250	6,8
+ 2500	3[illegible]	+ 185	1,9
+ 1500	21,2	+ 139	1,1
+ 850	9,3	+ 111	0,9
		- 111	1,6

FURNACE. During that first stage SO_2 concentrations up to 15,5% and iron pyrite charges reaching 45 tons/day were utilised, in order to diminish the O contents and to minimise SO_3 formation, thus avoiding the inconveniences which at the beginning were caused by the accumulation of residues both in the cooling coils and on the emanation electrodes of the electrostatic precipitator.

The frequent formation of these residues led to the need for periodical cleaning of the pipe coils approximately every 30 days when quantities of dust up to a maximum of 8 tons were collected whilst the build-up was even more frequent in the electrostatic precipitator, and in some chambers usually did not permit of more than 8 days operation without cleaning.

The analytical result is given below of one of the tests. The constitution of the deposit varied with the running conditions.

Total S	22.9%	Zn	0,44%
S"	1.8%	As	0,33%
Total Fe	30,4%	SiO_2	1,50%
Cu	0,08%	Insoluble	1,76%
Pb	0,14%		

The deposits found at the electrodes of the precipitator showed an average composition of:

Total S	10,5%	As	0,90%
Total Fe	48,4%	SiO_2	2,54%
Cu	0.48%	Insoluble	4.00%
Pb	1.30%		

Besides, this procedure presented the inconvenience of the risk of slagging and difficulties in getting a final temperature of the gases suitable for the precipitator for which reason it was later replaced by the method of working with 12.5-13% SO_2 by suitably regulating the primary and secondary air supplies and at the same time reducing the temperature in the furnace itself - (turbulent chamber) -, thus also resultingin a less intensive conveying of fines to the boiler.

Apart from the influence of the temperature on slagging processes, the effects of the scarcity of air at the beginning of the operation with high SO_2 concentrations were also noted, giving rise to a partial formation of monosulfide which by constituting an element of easy agglomeration served as a nucleus for a severe slagging at a later stage.

Among the various analyses carried out with these slags let us point out one of them corresponding to the first stages of the operation caused by a possible rising of the temperature. At the tested sample three different parts could be distinguished: one completely melted; another reddish and spongy, and a third one, easily disintegrated, and showing signs of sintering. Average composition:-

	S"	Total S	Fe	SiO_2	Pb	Cu	Zn.
No.1 melted	2,68	6.31	57.72	10,76	0.68	0,26	0.64
No.2 spongy	3.02	7.22	50.38	14,45	0.82	0,23	0.52
No.3 sintered	1,85	2.11	56.36	14,19	0.76	0.23	0.53

Working temperature. A series of tests with the type of iron pyrites used by us showed that the optimum condition was to maintain a temperature of about 750°C in the turbulent chamber by regulating the proportions of primary and secondary air.

Under these conditions, the proportion of residues obtained in the boiler changes according to the temperature, as a rule rising with the latter in nearly fixed proportions for the same class of iron pyrites. This greater supply of fines and their subsequent carry-over indicates the decrepitation behaviour of the material. The table below shows the formation of residue at 690° and 730°

Temperature turbulent chamber	PERCENTAGE OF ASHES PRODUCED	
	Furnace	Boiler and Volvic tower
690°C	59%	41%
730°C	51%	49%

In extreme cases of iron pyrites with a percentage of particles smaller than 0,5 mm. the dust collected in the chamber is only 27%.

Below you will find an anlytical result of these residues of which we only point out some of the main elements:

		Furnace	Air Chamber	Boiler
S	%	1,19	1.54	1.55
Cu	"	0.40	0.60	0,40
Pb	"	1.35	2.21	1,20
Zn	"	1.37	1.02	0,85
As	"	0.56	0.67	0,36
SiO_2	"	2,94	2.89	3,41
Insoluble,dry basis	"	1.80	1,70	1,66

For the same sample the grading test of the furnace ashes showed the following result:

	ASHES COLLECTED IN THE FURNACE					
		Hopper		Overflow Pipe		Boiler
1000 microns	+	19,34	+	44,12	+	1,04
587	+	27,74	+	15.60	+	0.14
262	+	31,52	+	23.38	+	0.16
212	+	7,85	+	7.30	+	0,86
168	+	10,02	+	8.90	+	30.77
118	+	1,09	+	0.41	+	30,83
75	+	1,44	+	0.16	+	25.26
75	-	1,00	-	0.13		—
31					+	1,93
22					+	1.11
15					+	0.85
15					-	7.05

Within the above mentioned conditions, the average temperatures in the different parts of the circuit are the following:

Temperature chamber	Entrance temperature boiler	Final temperature boiler	Difference.
690	740	440	300
730	690	390	300

Both refer to the same composition of gas, only the proportion between the secondary and primary air has been changed.

Gas concentration. Although at the present moment the furnace is operated with SO_2 concentrations between 12,5-13%, earlier tests were carried out with higher concentrations which are summed up below together with the temperature ranges.

Entrance temperature boiler	Exit temperature boiler	Temperature difference	SO_2%
800°	450°	350°	15
770°	440°	330°	15
750°	410°	340°	14
740°	400°	340°	14
720°	390°	330°	13.5
690°	360°	330°	13.5
690°	370°	320°	12.5

Although under equal conditions of quality and quantity of iron pyrites the difference between the entrance and final temperature of the boiler shows very similar values, the most favourable results corresponded to the low concentrations and temperatures which also permitted a better running of the electrostatic purifier.

SO_3 Formation. The analyses carried out under different operating conditions and with different charges showed the following results:

	Charge	SO_3 Gr/m³N Entrance boiler	EXIT Boiler	EXIT Electrof.
1st Stage				
Water cooling	42 tons/day	3.5	5.0	3.6
" "	35 " "	4.1	6.2	2,6
" "	33 " "	3.6	4.8	3.6
" "	33 " "	3.8	5,6	3.6
2nd Stage				
Steam cooling at 0,5 atm..	33,5 " "	3,5	4.2	3,6
" "	40 " "	3.5	4.2	-

After getting a SO_3 test in the boiler for the charge of 33,5 tons a formation of 148,3 Kg/day of SO_3 resulted in the boiler equivalent to 0,48% of the total amount of SO_2 produced.

Furnace and Boiler Corrosion. They constitued the most serious problem of this plant. Whilst during the first stage of operation with refrigerating water, dust accumulations in the pipe coils were prevailing both in the turbulent chamber and the boiler, these accumulations in the pipes disappeared in the second stage of low pressure steam refrigeration (0.5 atm.), but corrosion persisted to the same extent.

Most corrosion occurs in the turbulent chamber and cooling plant, which require frequent repair and only to a lesser extent in the pipe coils which have a longer life because of the steel protection with cast iron casing. Whilst in the turbulent chamber and cooling plate corrosion occurs after a few months, it did not appear in the pipe coils before the end of a year.

As a rule, corrosion occurred in certain favourite locations for each of the plant units.

Turbulent chamber. The sector most affected by corrosion corresponds to the water entrance and to the location zone of the pyrometer. Both are also the favourite zones for the formation of slags.

Cooling Plate. Top part and the zone near the draining of iron pyrites.

Pipe Coils. Principally at the superior and inferior zones of the coils at which gas circulation is rather defective. Recently the extreme sectors have been reforced but we have insufficient experience of this at the present moment.

Metal Casing. After one year of operation some corrosion appeared at the steel sheet externally protecting the refractory material, preferentially at the anterior part of the furnace where it was necessary to replace some sheet or other. The inside of these sheets has been recovered with a potassium silicate coating.

Refractory Material. After three years it is still in good condition despite the frequent lightings up and rapid coolings to which it has been exposed during the cleaning operations. No notable disturbances have been seen in the refractory brick dome.

During the course of this first stage, it was necessary to introduce some modifications which helped to improve the operating conditions and to avoid failures. These we are going to mention now:

Feeder. As a rule it operated well, except for some jammings mainly caused by an excessive moisture content of the iron pyrites or formation of ore blocks at the bottom of the rotating disc or between the latter and the walls. They have been avoided by installing some drag scrapers which gave successful results.

One of the valve devices for volume control which at the beginning could not be handled from the outside and which on account of its mounting conditions has been a frequent reason for defects owing to the wear caused at the guide frames was modified, too. At the present moment it has been mounted with upward movement to be controlled from the outside, and runs satisfactorily.

Air Distribution. The intermediate control valves provided to vary the amount of air along the bed which have been considered inefficient have been left out; thus the air distribution chamber has been simplified. Only the general control valves for the primary and secondary air still exist.

The original mounting of the air distribution box with flat bottom gave rise to dust accumulations causing stoppages of about 8 minutes every 12-14 hours for cleaning purposes. Since it has been replaced by another device with a hopper shaped bottom, the difficulties disappeared.

Iron Pyrite Feed Hopper. The bottom part of the hopper near the rotating disc is usually exposed to a good deal of wear which according to the kind, grade of fineness and moisture content of the iron pyrites needs a more or less frequent replacement, with the consequent stoppage of the feeder. A cylindrical, overlapping and sliding body has been constructed permitting it to be used without any kind of replacement for a long period of time and its rapid replacement. Its maintenance has also been improved by using a vibrator at the hopper with which the removal of the iron pyrites can be realised with greater uniformity.

Pipe coils. At the present moment some modifications are being tested at the joints of the cast iron tube lining which offered weak points on which, however, a definite opinion cannot yet be stated.

Electrostatic precipitator. The frequent shut-downs of the furnace together with the periodical obstructions at the boiler during the first months, at the beginning disturbed the normal running of the electrostatic precipitator, giving rise, especially in the first chambers, to the formation of big dust accumulations at the electrodes. The cleaning of these parts constituted a long and troublesome task which, furthermore, necessitated starting the fan of the sulfuric acid apparatus in order to eliminate gases, thus originating - besides the troubles caused by the shut-down - supplementary expenses for nitric acid at the start-up.

Apart from the influence of the entrance temperature of gases which was affected by the running conditions of the boiler - dust obstructions and lack of cooling - the inadequate intensity of vibration at the emanation electrodes was discovered. Vibrators were changed, transferring those of greater power to the emanation electrodes, and suspension bridges were modified so that more complete transmission of vibrations resulted. At the present moment it is worked at 275 kg, with a frequency of one minute and a vibration of 15 and 25 seconds, according to whether it is the question of emanation electrodes or of metal cloths.

These modifications also obliged us to reinforce the supporting tubes of the frames which on account of greater vibration got detached or even broken.

It has also been necessary to make the two last chambers heat-resisting where some acid condensation occurred during shut-downs.

At the present moment the electrostatic precipitator runs well and according to the grade of fineness of the iron pyrites employed is picking up approximately 21 to 34% - on an average 26% - of the total mineral burnt. With not excessively fine iron pyrites the electrostatic precipitator is efficient enough with only three chambers, thus leaving one or two spare chambers according to the conditions of the ore.

As a rule, the chambers work with a gas pressure of 6-10 mm. The normal voltage is about 56 kv and the consumption of each chamber is 15 mA.

To obtain the best efficiency of the precipitator, the final gas temperature should not exceed 440°C - taking into account the temperature drop up to the precipitator. The normal average temperature is 390°C; however, in cases in which because of a deficient gas cooling 500°C have been reached, purification of gases has been rather defective and big deposits have been formed at the electrodes which before long require the chambers to be taken out of service.

One of the tests made on the formation of SO_3 at the precipitator, with the furnace running at a charge of 33,5 tons/day of iron pyrites showed the following results:

Ashes collected at the precipitator.....	Anterior chambers	(5.650 kgs)....	25%
" "	Posterior "	230 "	1%
Total amount of sulfur...........	Anterior chambers....	2,92%	(2,45% in form of sulfate)
" "	Posterior chambers...	5,85%	(5.72% " " ")
Entrance gas.........	5.6 gr. SO_3/m^3N		
" ".........	3.6 " " " "		

The SO_3 balance showed a result of 204 kg. at the precipitator equivalent to 0,62% of the total SO_2 production.

SECOND STAGE.

It differs from the first mentioned one by the running of the furnace with gas cooling based on low pressure steam (0,5 atm.) The steam condensed in a 60 m^2 condenser feeds the cooling circuit of the furnace and the boiler by forced circulation, thus reaching higher temperatures at the external walls both in the chamber and the boiler tubes, at the latter approximately 115-120°C.

This change avoided the formation of dust sediments at the pipe coils which formerly obstructed the gas passage and frequently caused shut-downs necessary for their cleaning which in the first year represented almost 20% of the total running hours. The reduction of the number of shut-downs facilitated the running regularity of the sulfuric acid plant as well as a better maintenance of the pipe coils. At the present moment coinciding with a remarkable improvement of the installation the shut-downs do not reach up to 5% of the total running hours which gives rise to a partial elmination of factors favouring corrosion of the pipe coils.

Although before that stage a charge of 45 tons/day of iron pyrites was reached at the furnace, the necessity of getting a gas temperature suitable for the precipitator together with the reduction in cooling efficiency caused by the use of steam, obliged us to diminish the charge to 33-33.5 tons. The furnace has been running under these conditions until recently the number of pipe coils has been increased, thus permitting an increase to a charge of 40 tons of iron pyrites which we are probably going to surpass.

During the same period of time, some of the above mentioned modifications were introduced, and some improvements at the joints of the cast iron protection of the pipe coils were tested which offered a zone suitable for corrosion. Although the results seem to be favourable and it is expected that the life of the coils may be increased, more time will have to pass before firm conclusions can be reached.

Nevertheless, experience confirmed that corrosion persisted in the turbulent chamber and that the temperature reached with the low pressure steam is not sufficient for avoiding it, for which reason the conversion into a system of 30 atm. steam is being studied. Subject to this project and on account of the interest which the present system represents in our case for small plants, all possibilities are being tried before effecting the change and all practicable modifications which might make the system work are being studied.

In the meantime the operation during this stage as well as the experience gathered during the previous one permitted fixing the best running conditions of the plant assembly. Apart from the general prescription for that kind of furnace, the frequency of start-ups as well as of long periods of stand-stills to which the plant of Pontevedra is submitted obliged us to pay great attention to these operations and to take even greater care at the start-ups, making a moderate use of the sulfur and burnt iron pyrite mixture and making sure that the time necessary for reaching the normal temperature does not exceed 40 minutes and that the bed in rest occupies 35-40 cm.

At stand-stills of a longer duration, during which the furnace was not lighted up - some of which lasted up to 18 hours - the furnace was maintained without any difficulties by adding a mixture of burnt iron pyrites and sulfur, the latter was not used in excess in order to avoid the production of agglomerates.

The best running conditions were reached by:

1. Regulating the maximum pressure of the furnace at about 700 mm.

2. Finding out an adequate relation between the primary and secondary air so that the pressure variations have a range of about 50 mm. and a frequency of 70 per minute.

3. Normal temperature of about 750°C.

4. Concentration of gases not higher than 13.5% of SO_2.

5. Gas exhaustion of the boiler at a temperature not higher than 440°C.

After previously describing the main conditions of the sulfuric acid plant whose installation can be considered similar to that of others already known we think it unnecessary to give more details or to depart from the main object of these remarks the purpose of which is to offer the result obtained by associating the turbulent furnaces with the manufacture of sulfuric acid in an intensive system of ordinary steel towers.

Taking into account the high concentration of the SO_2 on leaving the furnace, it will be necessary partially to dilute these gases before they enter the Glover Tower, and also between the Glover tower and the first volvic tower. After this dilution the gases normally enter the Glover with 10-11% of SO_2. and the volvic tower with approximately 7%.

As an example, we include a chart with some data concerning the running of this plant for the production of 47.3 tons/H_2SO_4.

The various problems mentioned in the previous paragraphs constituted a hard test for the sulfuric acid plant which in spite of the frequent shut-downs and the long duration of some of them, operated very satisfactorily.

Even during the first two months of operation during which various defects of the furnace and the electrostatic precipitator caused about 20 shut-downs with a total of 400 hours, it was possible to appreciate the rapidity with which stabilisation of operations was reached.

At the present moment, after about three years of operation, the tower plant confirms its flexibility and great stability. During the whole period no defects occurred in the sulfuric acid plant, nor did there appear any corrosion of the steel towers or coolers.

The experience gathered permits an assurance that the coupling of the B.A.S.F. furnaces with this tower system can lead to good results, provided that corrosion is avoided in the furnace itself, by cooling the gases with pressure steam.

The consumption of nitric acid for normal operations can be estimated at 0.70 - 0.80%, the conduits of the plant being rather simple.

Iron pyrites .... 33.5 tons/day
Moisture content 1.5%
S (dry basis) 48.2%
S in ashes 1.67%

<u>Distribution of ashes</u>:

Furnace	45.8%	.... 1.19 % S
Overflow-pipe .	12.3%	.... 1.54 % S
Boiler	16.5%	.... 1.55 % S
Electrostatic precipitator	25.4%	.... 3.08 % S

	Glover	Volvic Tower	Tower I	Tower II	Tower III	Tower IV	Gay I	Gay II
Gas temperature:								
Entrance	$275^{o}C$	$86^{o}C$	$94^{o}C$					
Exhaustion	$90^{o}C$	$94^{o}C$	$54^{o}C$	$54^{o}C$	$42^{o}C$	$44^{o}C$	$37^{o}C$	$37^{o}C$
SO_2	10.8%	6.9%	4.9%	1.05%	0.22%	0.07%	traces	traces
N_2O_3		1.5%	2.32%	3.4%	1.76%	1.16%	0.14%	
Water irrigation	257 l/h	475 l/h	200 l/h					
Weak nitrous irrigation (22.4 gr/l N_2O_3)......	4.6 m^3/h	4.6 m^3/h					3 m^3/h	
Strong nitrous - irrigation (syrup)(166.6 gr/l N_2O_3)	115 l/h	725 l/h	46.3 m^3/h	12.4 m^3/h	6.6 m^3/h	9.7 m^3/h		
SO_2 fixed	26.8%	18.70%	43.6%	8.7%	1.5%	0.7%		
H_2SO_4 produced .	529 K/h	370 K/h	860 k/h	172 k/h	29 k/h	14 k/h		
Composition H_2SO_4	76.86%							
Composition N_2O_3		26.4 g/l					37.1 g/l	2,8 g/l

Production .... 47.330 kgs. H_2SO_4
Nitric consumption .... 0.75 %

SUMMARY.

The author described the running of an installation for the manufacture of sulphuric acid with an intensive system of ordinary steel towers and with a turbulent bed B.A.S.F. furnace for the calcination of pyrites, drawing conclusions as to the most favourable operating conditions for the installation as a whole.

With regard to the calcination furnace the author described two different stages, the cooling of the gases by water and by low pressure steam, indicating the results obtained by each of the processes.

The installation operated with an average conversion of 99.5% of SO_2 and a consumption of 7-8 kgs of nitric acid per ton of H_2SO_4. The operating conditions were satisfactory and as far as the manufacture in the steel towers is concerned, great stability and easy maintenance were confirmed. Corrosion of the furnace, however, occurred frequently and consequently we are studying, at present, the possibility of a change permitting the use of steam at a pressure of 30 atm.