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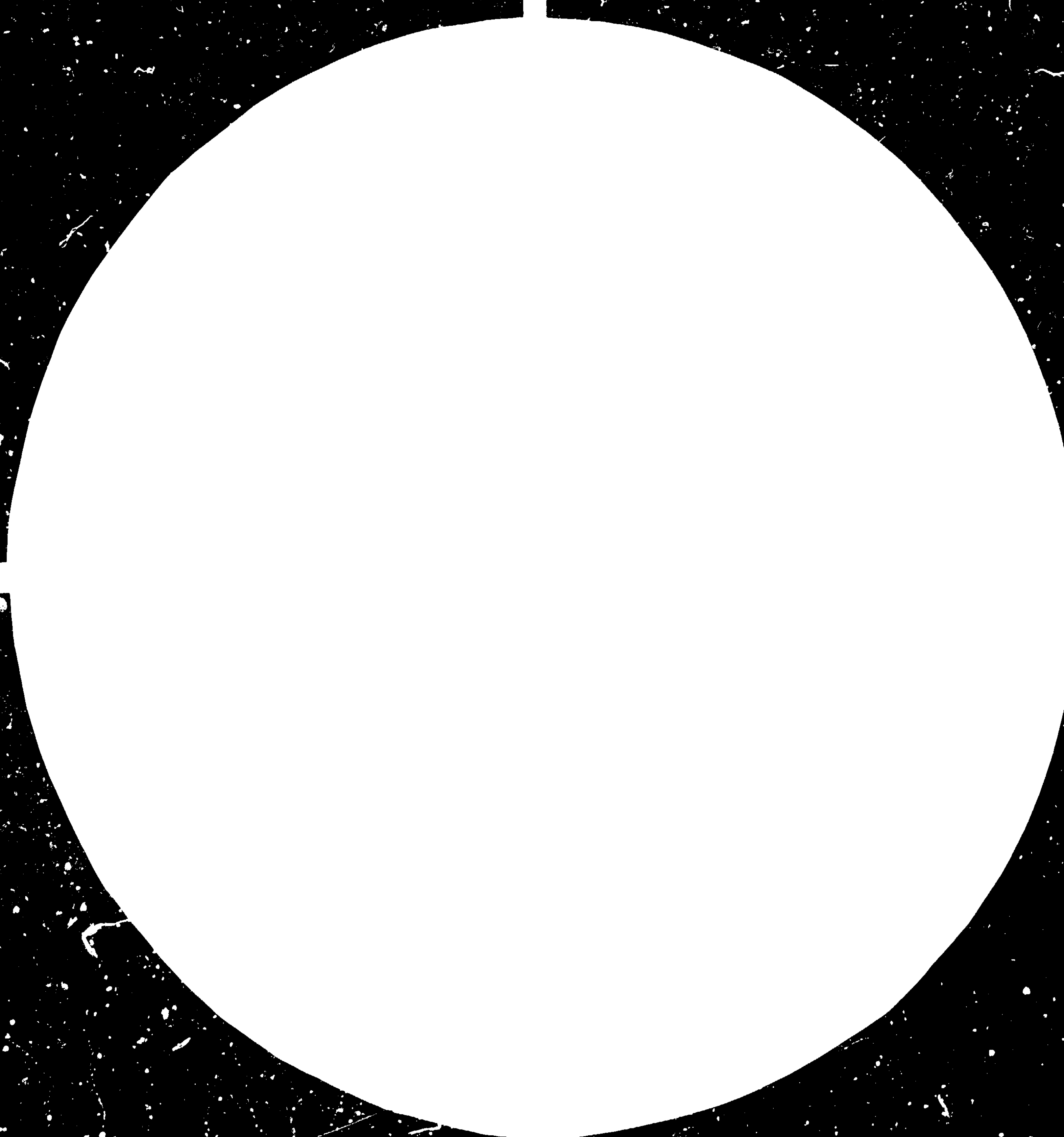

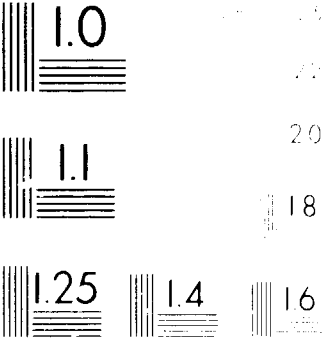
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5 January 1983
English

SEKA TURKEY . (Clay deposits).

DP/TUR/75/053

Final Report

by

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of

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Vienna

Introduction.

If one looks at the possibility to fractionate available kaolin it is necessary to check the following circumstances:

1. Properties of the clay for the wanted applications.(In this case paper filler and coating clay)
2. Balance of clay fractions with the amounts of clay used in production. (Blending with qualities externally bought or selling excess productions from some fractions is always possible)
3. Examination whether the ecological circumstances allow for the operation of fractionation.

(4. At this stage economical motives are dealt with only superficial).

If all these circumstances are positive a fractionation plant can be developed. A principle flowsheet of such a plant and a indication of the necessary equipment is attached.

Preceding information.

In April 1982 I received a sample of kaolin, which was supposed to be a a filler clay, together with laboratory reports from SEKA.

Investigation at KNP laboratories gives the impression that it was a crude mined sample. This was confirmed by SEKA.The laboratory reports from SEKA show a great variation in composition, which differs from pure kaolin. Loss on ignition determined at KNP was high.

August 1982 I received two other samples of kaolin, one of crude clay and one of filler clay after treatment at Dalaman. I also received laboratory reports and a flowsheet from the clay treatment plant at Dalaman.

These clays again were investigated at KNP (see table 1)
SEKA figures on composition combined with loss on ignition from KNP show:

	percentage				
	S_iO_2	Al_2O_3	total	S_iO_2/Al_2O_3	loss on ignition
theoretical kaolin	46.5	39.5	86,0	1.18	14
Dalaman;					
crude	44.7	26.5	71.2	1.7	19.1
filler	34.2	33.8	68.0	1.0	20.1

For coating clay one can say in general, that the chemical composition is less important, only as far as it influences the physical properties of coating and coated paper.

Properties on which coating clay should be tested are:

- -rheological properties in suspension and coatings.(this can be partly adjusted by binders and additives)
- -water retention of coatings.(same remark)
- -glossibility.
- -abrasivity.(on coating and printing presses, cutters)
- -ink receptivity and drying.(also partly to be influenced by binders and additives)
- -opacity.

I was informed that wire life at Dalaman was relative short, this points out to a high abrasivity value of the clay. This might come from the coarse fraction, but this has to be tested. Brightness is at the low side but could possible be improved by treatments as leaching and acidifying.

From the particle size analysis it seems to be possible to have the following yields in obtaining improved fractions from the crude mined clay;

crude clay	100 %
yield filler of Dalaman quality	50 - 60 %
yield filler of competitive quality	36 - 40 %
yield coating clay	27 - 30 %

The viscosity of the clay in aqueous dispersion is low which is a good property for coating clay.

To get a better idea a geological evaluation of the clay would be of interest. If wanted I can get an offer for such an evaluation from Dutch State laboratory (TNO) or a pottery mill at Maastricht. See also information from MTA later in this report.

The flowsheet given from the kaolin treatment plant at Dalaman needs more explanation with respect to number, size and pressure difference of cyclones.

There should be a sharper cut in particle size at 8 - 10 micron and no grit above 44 microns (325 mesh) to be competitive with English and American fillers. This usually is done in counterflow settling tanks and screens.

Flow sheet 1. Separation of a coating clay from a filler can be done by counterflow settling tanks, centrifuges or as done at KNP with multicyclones. We choose multicyclones because of the sharp cut in the particle size which is necessary for making sure that the highest particle size will be below 6-8 micron and 80 % below 2 micron.

According to consumption figures one has to dry either filler or coating or to blend or sell one of the products.

Flow sheet 1: concentrations (% is % by weight.)
LC-level control; CC-consistency control
PC-pressure control
multicyclones: Dorrclone type TM diam. 15 mm
condux: double disc tooth mill make Condux

Mill Visits

Izmit

Clay consumption 8000 t/year as filler. Storage about 2000 tons. Clay comes as crude clay from clay mining, generally according to the analysis given in table 1 and page 3.

The clay is grinded in ball mills working in batches which contain; 3 ton kaolin, 3 ton water and 3 ton stone grinding balls (7 to 12 cm. diameter). The mill runs a batch during 8-12 hours at 40 r.p.m. Grinding is controlled through sedimentation in laboratory. Production with 9 out of 12 mills is about 30 t/day. After grinding the slurry is diluted to 200-250 g/l and fed into the paper mill.

It is supposed that 10% coarse material is thrown out by the centricleaners of the stock preparation of the paper machine, but I believe it must be far more. Also the stock recovery from the Dunsch (sedimentation) system is interrupted from time to time.

This system has the following disadvantages:

- short wire life. With a speed of the paper machine of 150-180 m/min.:
  copper wire at 7-9% ash content of paper 25 days; at 0% ash 90 days.
  plastic wire at 7-9% ash content of paper 35 days, at 0% ash 10-12 months.
- They get complaints from the printers because of wear of printing plates and offset rubber blankets.
- There is a high pollution of effluent water.

Dalaman

Clay consumption: 10.000 ton filler (Turkey)/year
1.500 ton coating clay (SPS from ECC)/year
estimated future 5.000 tons coating clay/year

We discussed the laboratory evaluations and the expected yields of different qualities which can be produced from the crude clay as mentioned under "preceding information". We generally agree.

Filler clay is fractionated from crude clay according to flow sheet 2, but there are the same disadvantages as at Izmit. This is due to the size of the cyclones which is too big causing fines in the reject and coarse material in the accept, due to unsharp separation.

MTA-visit

(Maden Tetkik ve Arama Enstitüsü)

They claim that there are in Turkey big sources of clay in different places with variable compositions. Turkish clay consist of:

kaolin
alunite (K_2O. $Al_2O_3.SO_3$)
quartz (S_iO_2)
Fe_2O_3 (generally over 0.1%)

Alunite is responsible for the high loss of ignition and the missing part in the chemical analysis given at page 3. It is softer than kaolin and might be served as a good pigment for filler and coating.

Quartz is responsible for the abrasive properties of the clay. MTA put that this quartz is only present in particles with a size over 7-10 microns. With a good classification one should get rid of it. According to MTA the abrasivity of the filler made at Dalaman is caused by the poor classification.

Fe_2O_3 was on the high side and is present in the form of $Fe(OH)_3$ and easy to remove by leaching.

Clays among many other are:

Duvertepe, Fe_2O_3 <0.1% deposit $5\text{-}30.10^6$ tons.
Milhallicçik Fe_2O_3 2.1% deposit 5.10^6 tons.

MTA has a pilot plant for fractionation and should be able to make suitable samples of filler and coating clay for further investigation. For laboratory evaluation a sample of about 1 kg is necessary.

Discussion: quality of clay

General

The crude clay available is very abrasive. According to MTA this comes from the quartz content which only occurs in the fraction over 7 - 10 microns. The clay composition differs from kaolin through this quartz and alunite. This alunite is responsible for the high loss of ignition and the unknown missing part from the analysis so far. This alunite is soft and could be a good pigment for filler and coating.

Filler

Filler produced from this clay, at Izmit only ground, at Dalaman fractionated, in both cases still have too much abrasivity. The filler of Dalaman could be improved by better classification, see recommendations. The filler as it is now is of a too low quality for papermachine and printing paper.

Coating clay

For coating clay there is a further investigation necessary to establish whether the fine fraction of Turkish clay can be used for a fineness for coating (90% below 2 microns,100% below 6-8 microns). These samples should be analyzed chemically and geologically and tested for the properties of a coating as mentioned under preceding information.

To separate the wanted samples there are three possibilities:

a) Flow sheet 2 shows the clay treatment as it is done in Dalaman. By adding a pump to recirculate water from the Duru Su tank to the suction of the pumpwhich feeds the sedimentation tank 13-1-408 fine fractions of the clay can be caused to overflow. (see dotted lines) However, (appendix 1) calculations makes probably that clay in this system is not dispersed far enough to have coating fractions available. The clay slurry as it comes out of the sedimentation tank should be tested on particle size without any further treatment. If it is true that the dispersion goes not far enough, it could help to add a dispersion agent (0.3% calgon or polysalz) at the entrance of the "tromel" together with the clay. If this works there will be an overflow of the wanted fraction without any provisions for a circulation pump.

b) Ask a firm who produce classification apparatues i.e. centrifuges or cyclones to make semi technical trial runs with a good dispersed filler clay fraction. At KNP we used a small scale double disc tooth mill from condux and multicyclones from Dorr Oliver.

c) Make use of the pilot plant of MTA.

Conclusions and recommendations

- Filler clay as made now from crude Turkish clay at Izmit and at Dalaman is too abrasive for paper manufacturing and printing papers. There are complaints in both fields.
- The crude clay differs from kaolin in composition because of alunite and quartz. According to MTA the abrasion properties come from the coarse fractions (over 7-10 microns). This need to be tested.
- Improvement of the filler clay at Dalaman can be done by screening after the rotary ball mill (250 to 350 mesh) and having a multicyclone system (diam. 15-25 mm) at the last fractionation stage.
- If coating clay of a good quality can be produced the yield will be maximum 27-30% on a base of crude clay. If this will be done economically or an application can be found for the coarser fractions in other industries, a plant must be built according to flowsheet 1 which must be fed with a good filler clay quality obtained from the crude clay.

  Part of the coating clay production must be dried preferably in a spray drier to enable to obtain the necessary dispersing concentration of the clay for coating preparation.
- To make sure that the fractionated coating clay will meet the required properties it is recommended to do semi-technical trials as recommended under "discussion of quality of clay" to obtain the wanted fraction for investigation of properties as mentioned under "preceding informations" and chemical and geological analysis.

Remark

1. Serious consideration should be given to classify crude clay at the place of mining into a good filler with the coarse particles remaining. It will reduce the clay transport volume if it is done. Transportation of wet clay will give an easier handling.

Part of the Dalaman filler plant can then be used for coating clay fractionation. For the coarser fraction must be found an application in other industries, or it must be taken back in the clay pit which gives less pollution problems.

2. During the discussion at Dalaman the following idea developed:
Build a clay classification plant according to KNP system for the existing (1500t/year) wanted capacity. Buy foreign filler clay for this plant. This gives already a profit; based on raw stock these savings are estimated to amount about 17.10^6 TL. At the same time this plant can be used for further development of the application of Turkish clay.

Appendix 1 Dalaman final sedimentation tank.

The dimensions of the sedimentation tank 13-1-408 for thickening of the filler clay at the end of the clay treatment at Dalaman are:

diameter 10 m, height 1.9 m.

The load is about 8 m^3 water/hour with 1 ton clay/hour.

Theoretically all particles under 6 micron will overflow. Hindered settling could change this a little bit, but at this consistency not much. Because the overflow water of this tank is clear, the conclusion will be that the clay is not dispersed to a particle size below 6 microns.

That is good enough for filler clay, but not good enough for separating a coating clay fraction. So there must be done apparently more work on dispersion of the crude clay.

$$\text{sedimentation velocity} = v_s = \frac{g\, d_p^2\, (\rho_p - \rho_w)}{18\eta_w}$$

$$\text{upstream velocity in tank} = v_u = \frac{4\, q_w}{\pi\, d_t^2}$$

g = acc. of gravity ρ_p and ρ_w = spec. gravity of particle and water

η_w = viscosity water q_w = amount of water d_t = diameter tank

all c.g.s. units $v_s < v_u$ particle will flotate.

Appendix 2

There were various discussions about coated paper in general. Among others were mentioned:

- Importance of high shear viscosity of coating. Information on Hercules High Shear viscosymeter will be sent.
- CMC as a waterretention aid is preferably above synthetic additives which are used to increase viscosity.
- Waterretention measurement as done at KNP looks primarely after the situation of the coating during loosing water. This is particularly important for a pigmented coating on a size press, but has also to do with the runability of a blade coater. A paper presented at a TAPPI coating conference will be sent.
- Microscopic inspection of the surface of coated paper and its relation with problems at the PM and complaints by the printers. A demonstration was given.
- Tape control of paper sheet piles to control production of dust from the cutters. Demonstration was given.

This report could be made thanks to a number of very good and fruitful discussions. The main contacts were with:

Izmit : mr. Z. Yelen
mrs.B. Eryener
mrs.G. Gürer (interpreter)
mr. A. Çiçtci
mr. E. Gensoğullan.

Dalaman : mr. A. Karakuzulu
mrs.G. Beslek
mr. E. Türegüm
mr. A. Ergin

MTA : mr. R. Kutlu
mr. I. Bozdoğan.

TABLE 1

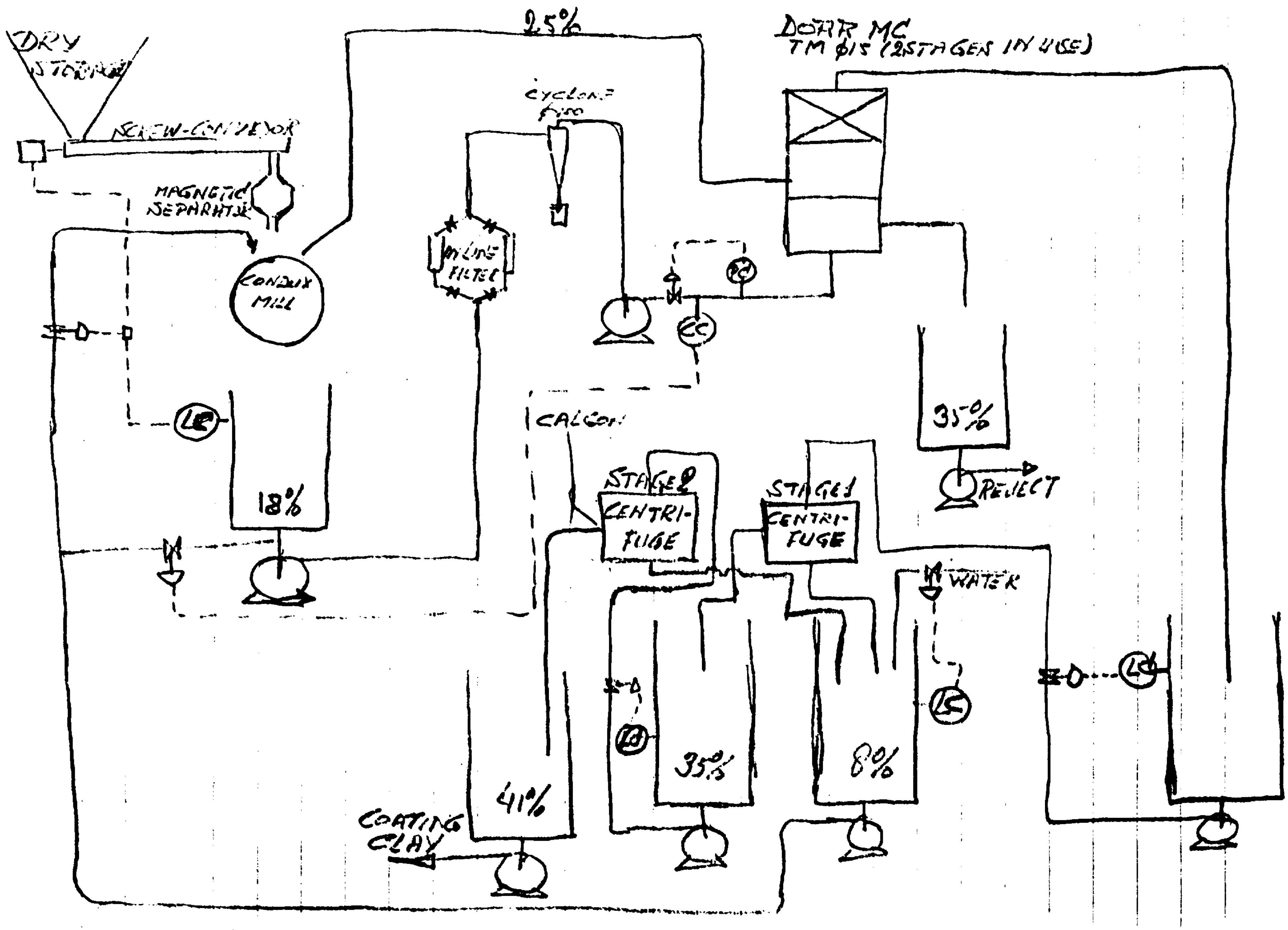
		kaolin from Dalaman		competetive
		crude	filler	filler (English clay) grade C
moisture	%	4.0	3.4	10
iron	%	0.014	0.025	<0,06
T_iO_2			0.3	
	X		84.7	86.8-88,2
Elrepho filter	Y	1)	80.8	85.8-87.3
	Z		72.7	81.5-83.1
particle size <8	%	56.5 2)	65	88.5-94.5
<5	%	46	54	76.5-86.5
<2	%	32	34.5	53.5-65.5
<1	%		24.5	39 -51
remains sieve 325 mesh	%	-	15.9	< 0.01
p_H (10% susp.)		6.9	8.2	4-6
loss on ignition	%	19.1	20.1	10-12.2
Brookfield 3 100rpm.				
disp. concentration	%		67.2	
viscosity mPa s			180	
Hi-shear 4450 sec^{-1}				
disp. concentration	%		63.0	63.0
viscosity mPa s			28	180-400
specific gravity.			2.53	

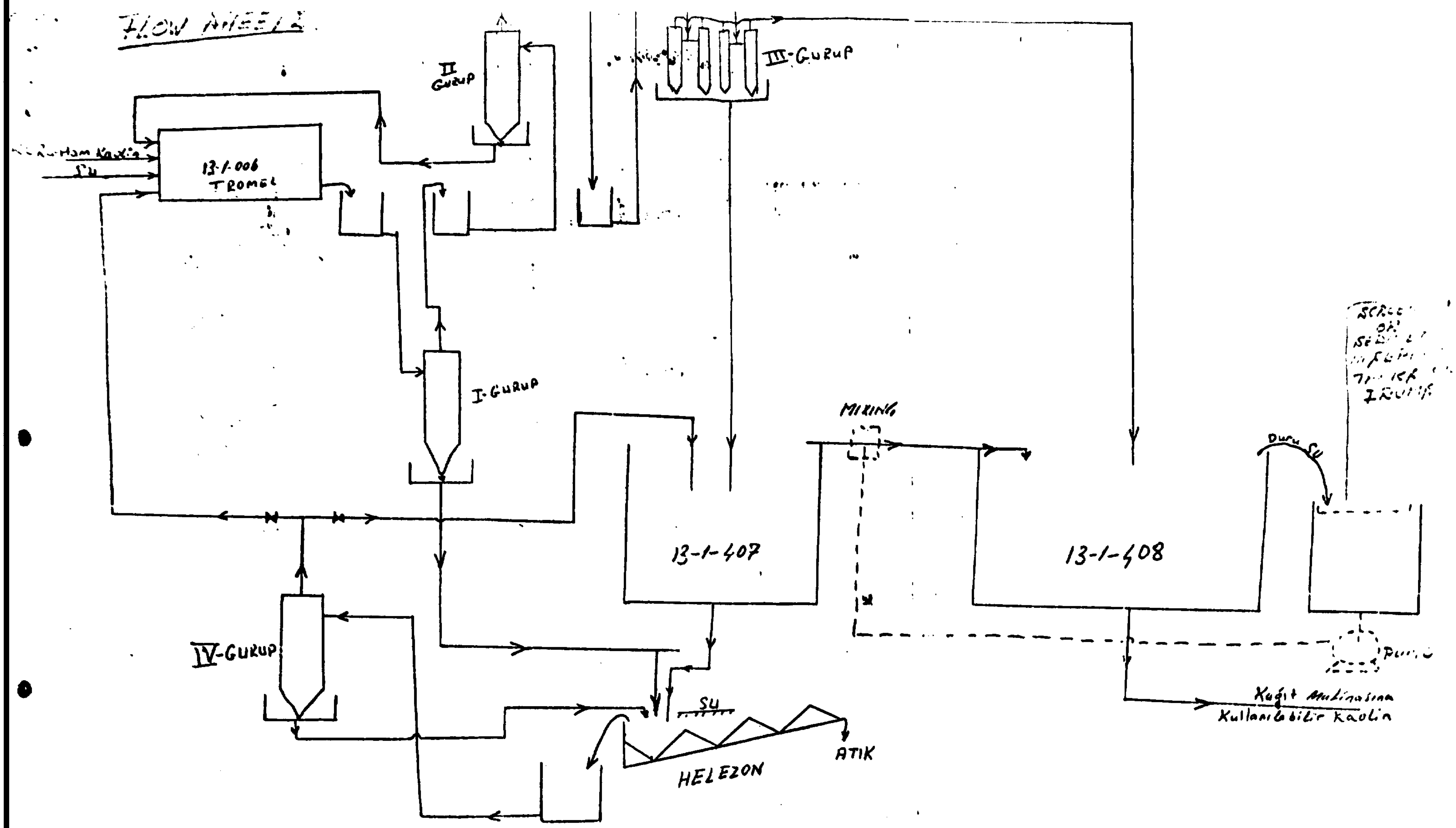
1) could not be measured because of 40% small stones in the sample.
2) after dry sieving over 0.3 mm. sieve

T_iO_2 is between english and U.S.A. clay.

FLOW [illegible] 1

SEPARATING COATING CLAY FROM FILLER





KAOLİN TESİSİNİN 15-6-1982 TARİHİNDEKİ DURUMU