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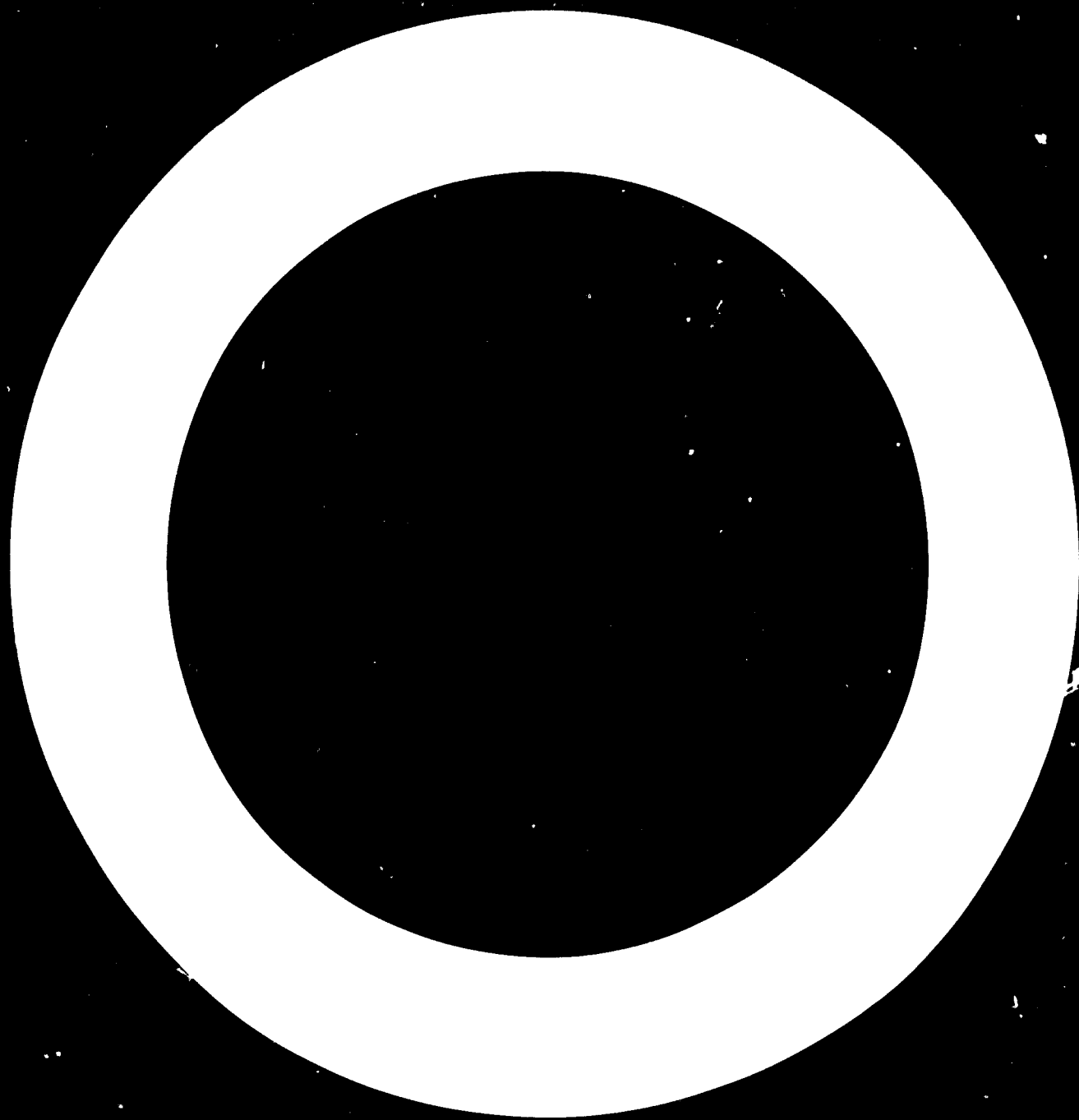
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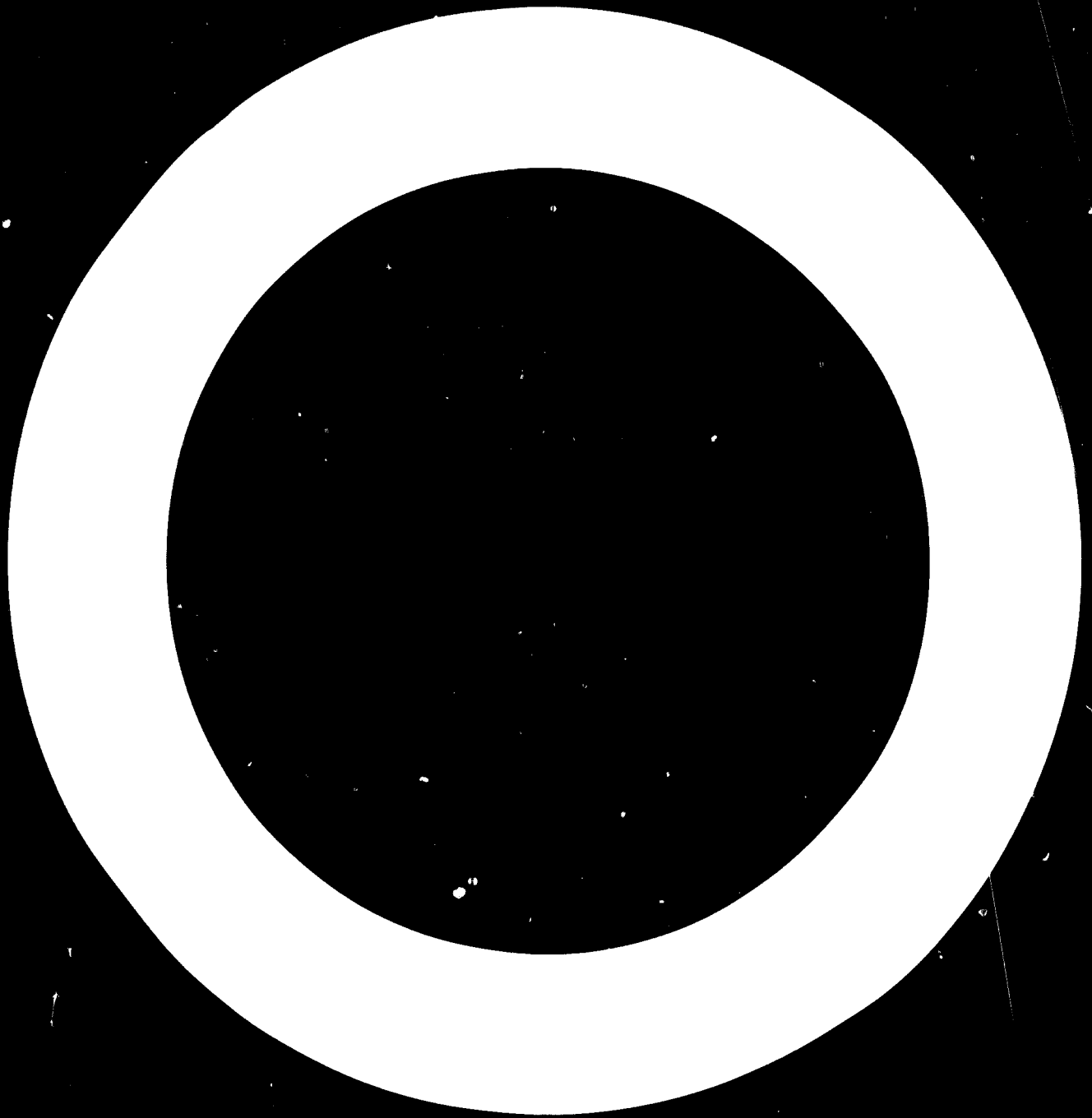
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1. TECHNOLOGY OF THE BAYER PLANT

1. ABDUL KADER, J.A.M. et alii: Electrowinning of gallium: Studies with concentrated soda solutions in the Bayer cycle. Trans. Soc. Adv. Electrochem. Sci. Technol. Vol. 10. No. 4. 1975. Oct-Dec. pp. 249-254.

A conc. solution from the Bayer process contg. Ga 200-300, V 10-15, Al 70-100, and NaOH 370-400 g/l. was electrolyzed using Ni-plated mild steel strip as anode and Hg or a Hg-5% Na amalgam as the cathode. The anode to cathode area ratio was 1:10. Ga collected in the Hg pool. Yield improved with increase in c. d., but above 0.28 A/dm² total Ga yield decreased. Under optimum conditions, ~ 75% of the Ga in solution could be recovered with an efficiency of 5%.

2. ABRAMOV, V. Ya. et alii: Determination of the test sampling error in alumina production based on flow control data. Trudy VAMI, No. 88. 1974. pp. 100-104. /Russian/

A test sampling method was developed for in-plant production control of leaching of bauxite sinter material. Root-mean-square deviations in chemical analysis data were determined at two plants. Equations were derived for statistical parameters related to alumina production. The average difference in the parameters was related to the individual chemical variations in different sectors of production, operation of the production units and time interval of testing. By using the test sampling method, an improvement in alumina extraction yield of 2-3% was realized.

3. ABRAMOV, V. Ya.; DUDKO, T.A.: Study of the hydraulic resistance of a polydisperse sinter cake in the process of leaching. Trudy VAMI, No. 88. 1974. pp. 83-87. /Russian/

A study was conducted on the pressure loss of a leaching solution flowing through a slime sinter cake. The particle distribution and average particle size of the slimes used in the study varied over a wide range. The pressure drop was determined as a function of Re number, flow rate, slime type and cake layer thickness /Cozeni-Karman equation/. The Cozeni-Karman constant for the above system was determined to be 3.4. 8 ref.

4. ABRAMOV, V. Ya.; REYFAM, B. D.: Calculating continuous-flow leaching of aluminate sinters. *Cvetnye Metally*, No. 7. 1976. pp. 36-40. /Russian/

Mathematical models for the different stages occurring during leaching of sinters were determined based on constant sinter particle size, temperature and extraction liquid concentration. The chronological process was divided into intervals in which the values of the extracted liquor concentration and temperature were assumed to be constant. The leaching process of Al_2O_3 in each interval was described by a system of equations for material balance, extraction kinetics, kinetics of Al_2O_3 losses with hydrogarnets and kinetics of Al_2O_3 losses with sodium aluminium hydrosilicates. An examination of various data showed that the synthesized mathematical model was adequate for the processes occurring during leaching. The model is recommended for practical applications.

5. ABRAMOV, V. Ya. et alii: Technical-economic analysis of different methods for leaching bauxite cake. *Cvetnye Metally*, No. 11. 1975. pp. 38-40. /Russian/

An analysis was made of five variations of leaching methods: leaching the entire mass in a battery of diffusers; leaching by a combined method using a battery of diffusers to treat the large-sized fractions; leaching by the combined method using a vertical apparatus to leach the large-sized fractions; leaching by the combined method using the percolation method; and combined leaching using a tubular system. The results were used to select new equipment and to modernize existing systems and to develop new trends in the development of equipment.

6. AKSELRUD, G. A. et alii: Kinetics of washing a solution with red mud. *Trudy VAMI*, No. 81. 1971. pp. 90-97. /Russian/

The purpose of the present study was to determine the kinetics of the process of washing a solution with a fine red mud layer, obtained after leaching alumina-containing sinters. A laboratory setup was used to obtain experimental data on the weight of soluble material in solution as a function of treatment time. Treatment consisted of filtering and decanting. It was established that the theory of diffusion leaching of a layer of porous particles applies to the washing of red mud. Constants in the diffusion equation for this process were determined.

7. ALEKSEEV, A. I. et alii: Electrolytic separation of gallium from alkaline solutions. *Azerbajdzanskiy Himicheskiy Zhurnal*, No. 3. 1975. pp. 96-98. /Russian/

Gallium was separated from alkaline aluminate solutions in Al_2O_3 production. The yield of Ga in reference to the electrical current

on a Hg electrode from industrial solutions was considerably lower than from gallate solutions. Yields of 3.8-4% Ga were obtained when the solution was previously stirred with Hg. The latter led to formation of a dark-gray layer of slime on the surface of Hg, consisting of Cu, Ni, Fe and some other electropositive elements cementated by Hg. After the Hg treatment, a significant amount of impurities remained in the solution.

8. Alkali recovery from aluminate solutions used for pickling of aluminium /alloys/ and for alumina production from ore. No. 431,106 /27 Dec. 1971/. /Soviet Patent/

Solutions of alkali metal aluminates are treated with 3-5 mole calcium carbide/1 mole alumina in the solution; the alkaline phase /for example, sodium hydroxide/ is separated. Temperature is kept at 70°C or less. The extent of recovery is increased. Calcium carbide /312 g/ /2-4 cm pieces/ was reacted with alkali aluminate solution /1 l/ containing 113.1 g/l NaOH /free/, 247.7 g/l NaOH /bound/ and 165.8 g/l Al₂O₃ at not over 50°C for 25 hr. A solution of sodium hydroxide /0.52l/ was separated and combined with washings. The amount of acetylene obtained was 78.1 and 60.0 g/l concentrate sodium hydroxide 0.80 l.

9. Alkaline aluminate solution from alumina processing. As. Uzb. Chemical Institute. No. 507,526 /21 June 1974/. /Soviet Patent/

Alkaline solutions containing red mud formed during bauxite processing by Bayer's method is clarified using 400-500 g/ton of a low molecular, cationic flocculant of formula, where R is 9-15°C alkyl group and Ar is a substituted derivative of benzene, naphthalene or anthracene. More intensive mud solids flocculation is achieved. Some 600 g/ton of mud of the above flocculant are used and after 60 min the layer of clarified water in a test vessel is 75% of the total. With no flocculant it is 53%, and with other known flocculants it is 70 and 68%.

10. Alumina preparation from bauxite-alkali aluminate solution added in portions to improve separation of sludge. Aluminium Magnesium Elect. Ind. Re. Inst. No. 461,062 /23 Nov. 1971/. /Soviet patent/

Efficiency of the process is increased when the bauxite is treated with alkali aluminate solution, not in bulk, but in portions added in such a manner that at least 1 hr elapses between the addition of the first and the last portion of bauxite. This increases the rate of separation of sludge from the solution and hence the rate of decanting, by 16 times. Some 109.2 ml of alkali aluminate solution /I/ containing 247 g/l Na₂O /as alkali/, 25 g/l Na₂O /as carbonate/

and 118 g/l Al_2O_3 were warmed to $105^\circ C$ and seven 5.4 g portions of dry bauxite containing 43.4% Al_2O_3 and 20.5% SiO_2 added at 1 hr intervals followed by two 5.455 g portions of the same material, the pulp kept at $105^\circ C$ for another 2 hr /total time 10 hr/, diluted with a weaker solution /I/ and concentrated at $90^\circ C$. A clear layer of 10.8 cm height was formed after 15 min, while a control in which the bauxite was added in a single step and leached for 10 hr produced a clear layer of 0.65 cm height.

11. Aluminium solution purification. Pavlodar Aluminium Works. No. 468,887 /22 Aug. 1972/. /Soviet patent/

The title method, useful in Al industry, is based on removing silica from aluminate solutions by adding sodium-aluminosilicate /I/ and title additives /obtained by leaching clinker to give unclarified 15-20 g/l solutions/. The expenditure of additives is lower /20-30 g/l/ due to greater activity. Additive from leaching waste contains 26.3% /I/, 20.9% iron oxide hydrogarnet and 18.4% beta- $2CaOSiO_2$ /chemical composition /%/: SiO_2 11.2; Al_2O_3 15.2; Fe_2O_3 19.6; CaO 24.4; Na_2O 5.8; calcination loss 11.1/ is added as 15-30 g/l solution to aluminate solution at atmospheric pressure 3 hr at $100^\circ C$ gives silica modulus units in cleared solution.

12. APOLINSKAJA, R. M.; EREMIN, I. I.: Effect of alkali and accelerators on the technical characteristics of aluminocalcium sinters. Trudy VAMI, No. 81. 1971. pp. 40-46. /Russian/

An experimental study was made of the effect of Na_2O and accelerators /NaCl, CaF_2 , $CaCl_2$, etc./ on the characteristics of $CaO-Al_2O_3-SiO_2$ sinters. The alkali had a similar effect to that of CaO. In some cases, the Al_2O_3 extraction yield decreased with increasing Na_2O content; in other cases it increased. The effect was a function of sintering temperature and Al_2O_3/SiO_2 ratio. Accelerators intensified the sintering process, lowering sintering temperatures by 25° to $50^\circ C$. Depending on the accelerator used, there was a maximum effect at a given level, above which the Al_2O_3 extraction yield diminished.

13. ARLJUK, B. I.; FERKH, A. A.: Selection of fuel oil combustion conditions in alumina-production rotary kilns. Cvetnye Metally, No. 3. 1976. pp. 32-35. /Russian/

Optimal conditions for combustion fuel oils in the rotary kilns for alumina production and the relationship for calculating the maximum allowable size of fuel atomization under conditions of exclusion of fuel deposition on the material were determined. It was shown that in the kilns with size 5 x 185 as compared with those 3 x 60 and 3.6 x 150 mm it is possible to increase deposition of oil drops on

the material which leads to overexpenditure of fuel, sublimation of alkali from the cokes, reduced extraction of the alumina and closing of the screen chain. To improve the combustion conditions of fuel in kilns 5×185 mm it is recommended that the fuel pressure be increased to about 50 atm. 5 ref.

14. ARLJUK, B. I.; HERKH, A. A.: Selection of combustion of coal dust fuel in rotary kilns. *Cvetnye Metally*, No. 10. 1976. pp. 40-42. /Russian/

A mathematical analysis is made of the combustion and heat transfer in rotary kilns using coal dust fuel. The analysis was used to treat experimental data accumulated at seven different Al_2O_3 sintering plants. Coefficients in the equations were determined from the data, and these, used in the equations of combustion and heat transfer, allow predictions of flame length, temperature, etc. within 10-15%.

15. ARLJUK, B. I. et alii: Properties of hydrated alkali metal aluminosilicates. *Zurnal Prikladnoj Himii*, Vol. 48. No. 5. 1975. pp. 994-996. /Russian/

The composition of precipitates formed during heating at 100° to 230° C of aluminate solutions containing Na and K hydroxides, sulfates, chlorides and carbonates changes with the temperature and duration of treatment of the order zeolite to noselite to cancrinite. The presence of sulfates, chlorides and carbonates, and also of beta- $2CaO \cdot SiO_2$, causes the formation of less-soluble aluminosilicate hydrates, that is, of noselite and cancrinite, and thus also the separation of SiO_2 from the solution. The solubility of the precipitates in the aluminate solution from which the SiO_2 was removed /containing Al_2O_3 85, SiO_2 0.03-0.08, Na_2O 75, K_2O 35, SO_4^{2-} 4 and Cl^- 0.2 g/l/ is about 0.45 SiO_2 g/l at 100° C of the form close to zeolite and 0.11 SiO_2 g/l at 175° C of the cancrinite form.

16. ARLJUK, T. A.; TELJATNIKOV, G. V.: Crystallization of alumina from aluminum oxide hydrates, differing by preparation method. *Cvetnye Metally*, No. 1. 1976. pp. 43-45. /Russian/

Bayer method aluminum hydroxide crystallizes into alpha Al_2O_3 faster and at 1225° to 1250° C, a temperature applicable to plant calcining conditions and 75° to 100° C lower than the carbonation hydroxide at 1300° to 1350° C. This is due to the Bayer hydroxide microstructure which is hexagonal stepped-lamellar aggregate, while the carbonation hydroxide is prismatic divergent aggregate, and also contains some boehmite. The Bayer hydroxide contains only hydrargillite. The less coarse and the lower the alkali content the faster the crystallization rate for either method material.

17. ARONZON, V. L.: Methods for obtaining the algorithm in the system for controlling chemical-metallurgical production using a computer. *Himicheskaja Promislenost*, No. 2, 1975, pp. 117-123. /Russian/
- A method of developing an algorithm for computer control of a complex production scheme is presented. In most cases the losses caused by instabilities are directly proportional to the mean square deviations of parameters from the nominal values. The control strategy has to stabilize the quality of the intermediates leaving a production unit at the load corresponding to the desired total production. A block diagram of the control scheme is given. The method was verified in developing an automatic control system for charge preparation in an Al_2O_3 plant.
18. ASKEROV, A. Z.; TOKAREV, B. D. et alii: Flotoflocculation clarifying of muds from aluminate liquors. *Cvetnye Metally*, No. 5, 1975, pp. 44-47. /Russian/
- An investigation was made of the possibility of using flotoflocculation to remove red mud from aluminate liquors in the Bayer process and for the removal of suspensions /white mud/ in alumina production from aluminosilicates. Polyvinyl alcohol and its aldehyde derivatives were used as sludge collectors. When clarifying under identical conditions all the muds were taken up in the foam with the same efficiency. The mechanism of attachment appears to be intermediate between adhesion sticking of particles of flotation size and the adsorption of dissolved surface-active components in the liquors. 9 ref.
19. AVGUSTINIK, A. I.; STRAKHOV, V. M.: Kinetics of alumina dissolution in a feldspar melt. *Izvestija Vysših Učebnyh Zavedenij, Himija i Himičeskaja Tehnologija*, Vol. 19, No. 5, 1976, pp. 728-730. /Russian/
- The solution rate of alpha Al_2O_3 particles in feldspar melts increased from 4.6×10^{-5} at $1390^\circ C$ to 8.9×10^{-5} g/sq cm min at $1450^\circ C$, corresponding to an activation energy of 70.1 kcal/mole. Solution rates were determined by microscopic observation of spherical Al_2O_3 particles in contact with the melt.
20. Bauxite digestion by caustic alkali with improved heat transfer in tubular reactors. *Vereinigte Aluminium Werke AG*, No. 2307,922 /17 Feb. 1973/. /German patent/
- Bauxite suspension at 10-200 atm, and 200° to $300^\circ C$ is passed with velocity 0.5-7 m/sec /preferably 2-5 m/sec/ and especially with turbulent flow with Reynolds number 10^5 , having a solids content 1-6 vol %, and an average particle size 10-150 microns, through a tube or tube bundles heated by countercurrent flow /in a concentric tube/ of hot digested suspension, steam or other heating. Part of

the digested liquor containing red sludge is recycled through the digestion tube and the heat transfer coefficient K is increased by 5-8% of free feed operation.

21. Bauxite suspension for aluminum production freed from coarse particles by partial recycling to mill. Alutary Aluminiumpari Tervező Vállalat, No. DL 120,865 /15 Oct. 1975/. /GDP patent/

A bauxite suspension for Al production is prepared by passing the suspension /between the grinding stage and the dissolution stage/ through desilicizing tank/s/, 1-10% of the suspension being /dis/ continuously withdrawn from the lower part of the desilicizing tank /which is not provided with any stirring devices/ and returned to the grinding stage. The particle size range is improved and the dissolution of the bauxite is facilitated.

22. Bayer alumina extraction from bauxite containing goethite. Mitsui Mining and Smelting Co. Ltd. No. 2435, 223 /14 June 1974/. /German patent/

The extraction of Al_2O_3 from a bauxite containing Fe in the form of goethite by the Bayer process, using an aqueous caustic alkali solution is carried out at a temperature of $300^{\circ}C$ in the presence of a reducing organic substance /I/, preferably a colored substance, especially humine, in an amount of maximum 5 g/l aqueous alkali solution. The use of a higher extraction temperature and /I/ improves the extraction and also facilitates the sedimentation of the red mud.

23. BAYER, G.: An economic solution to get rid of red mud. In: Symposium on "Environmental protection in the aluminium and other non-ferrous metal producing industries", Stonehouse, Glos. 1973. Technocopy Ltd. pp. 12-20, 53-56.

Some recent possibilities for utilizing red mud are dealt with, especially in plants producing alumina by the Bayer process. Among these are the production of cast iron or steel from red mud by a direct two-stage reduction process: first bricks are processed from red mud; then a very active flocculation is used for purification of polluted water.

24. BELIKOV, E. A. et alii: Automatic control system for aluminate liquor carbonization. Cvetnye Metally, No. 3. 1976. pp. 36-39. /Russian/

A self-adjusting system for controlling the process of carbonation of aluminate solutions is described. The use of the system in controlling the carbonation process reduced the deviations of the real values of concentrations from the preset ones by two times as compared with the manual control system.

25. BELL, T. W.: The partition of starch between Bayer plant liquor and red mud. Gordon T. Bell, ALUMINUM Co. of America. In: "Light Metals 1976", Vol. 2. New York 1976. Metallurgical Society AIME, pp. 114-117.

The fraction of starch charged to limests of Suriname and Arkansas bauxites which is adsorbed by the resulting red mud remains essentially constant up to a charge of 0.5 to 1.5 g/l of bauxite after which it decreases, indicating that beyond this range an excess is being used. The point at which the decrease starts is in the range of starch charges used in plants treating these bauxites. The surface concentration of starch adsorption on red mud is a function of its concentration in the green liquor and is not appreciably affected by soluble organic compounds which exist in Bayer plant liquors. When starch is charged to the limest with the bauxites, optimum adsorption occurs after 10 to 25 minutes of digestion, a period corresponding to the retention time in plant digestion systems. Under plant digest conditions and starch charges 70% of the starch charged is adsorbed by the red mud, about 10 to 15% if the adsorbed starch is desorbed during holding red mud in red mud settlers, and about 5% is desorbed by washing.

26. BEREZA, L. V. et alii: Quantitative description of the dependence of gibbsite solubility on the solvent concentration and temperature in the sodium oxide-aluminum oxide-water system. Trudy Instituta Metallurgii i Obogasheniya Akademii Nauk Kazanskoi SSSR, Vol. 50. 1975. pp. 88-90. /Russian/

The temperature dependence of gibbsite solubility $/y_a/$ in the system $\text{Na}_2\text{O}/N/-\text{Al}_2\text{O}_3/y/-\text{H}_2\text{O}$, where N , y , y_a are concentrations in g/l, is given for 50° to 100° C.

27. BERKH, V. I.; KRASNOPOLSKY, E. D.: Method for determining the optimum temperature for the decomposition of an aluminate liquor based on a mathematical /kinetic/ model. Trudy VAMI, No. 41. 1975. pp. 130-134. /Russian/

A kinetic model was used to determine optimum decomposition temperatures for aluminum hydroxide from sodium aluminate solutions. Besides temperature, basic parameters determining decomposition in these solutions are Al_2O_3 content, caustic modulus /molar ratio of caustic alkali to $\text{Al}_2\text{O}_3/$, loss modulus /weight ratio of hydroxide lost to Al_2O_3 content in solution/, initial and final temperatures and process duration. Based on computer solution of interdependent process equations, it was found that optimum temperatures for increasing time intervals decreased from 53.5° C /0-10 hr/ to 44° C /40-60 hr/, which are somewhat lower than the initial and final temperatures used under industrial conditions.

28. EBERTJAKOVA, L. V.; POLJAKOV, A. I. et alii: Study of aqueous sodium aluminate solutions in a wide range of concentrations and temperatures. Izvestija Akademii Nauk Kazahskoj SSR, Ser. Fiziko-Matematicheskaja, Vol. 13. No. 2. 1975. pp. 38-42. /Russian/

The dependence of the proton spin lattice relaxation time on the concentration and temperature shows that in the solutions of low Na_2O concentration /100 g/l/ $\text{Al}/\text{OH}/^{-4}$ ions are present, which associate when the concentration of Na_2O increases and when α is less than 3 / α is the ratio of molar concentrations of Na_2O and Al_2O_3 /. When α is over 3 $\text{Al}/\text{OH}/^{-4}$ dominates over other forms of aluminate anions up to the Na_2O concentration 200 g/l. When Na_2O concentrations are over 200 g/l, dehydration of the $\text{Al}/\text{OH}/^{-4}$ anion takes place.

29. BIKLEBELDT, K. et alii: Heat consumption in the production of aluminum oxide. Erzmetall, Vol. 29. No. 3. 1976. pp. 120-125. /German/

Energy consumption in the production of alumina from bauxite by the Bayer process is discussed. Important factors in the consumption are the transport of bauxite, extraction, evaporation and calcination. It is shown that the energy consumption can vary considerably and can be influenced by the processing technique. Whereas the energy consumption for calcining, using the fluidized bed technique, cannot be reduced significantly, extraction and evaporation are processing stages which can be greatly affected as far as energy consumption is concerned. The quality of oxide that is aimed at has a large influence; it is to be hoped that under the pressures to economize in energy there will be an adjustment of American and European oxide qualities.

30. BRIN, V. G.; EREMIN, I.I. : The thermodynamics of chlorinating aluminum ores. Trudy VAMI, No. 81. 1971. pp. 32-39. /Russian/

A thermodynamic analysis was made of 30 different chlorination reactions of Al ores with various component reactants. The temperature dependence of the standard isobaric-isothermal reaction potential is presented for each reaction. It is shown that in the chlorination of iron and titanium oxides without reducing agents present in the temperature range 800° to 1300° K the reaction occurs at a very slow rate. Iron sulfides could be chlorinated without reducing agents present. The presence of reducing agents in the chlorination of oxides of Fe, Ti, Al and Si shifts the equilibrium to the product side. If O is present in the gas phase above the equilibrium level, the chlorides are oxidized and the Cl can be regenerated.

31. CATONY, D. I.; MATIJEVIC, E.: Aluminum hydrous oxide solutions. Pt. 2. Preparation of uniform spherical particles by hydrolysis of aluminum sec-butoxide. Journal of Colloid and Interface Science, Vol. 48. No. 2. 1974. pp. 291-301.

Aluminum hydrous oxide colloidal dispersions consisting of spherical particles of narrow size distribution were prepared by hydrolysis of Al sec-butoxide in aqueous sulfate solutions followed by aging at elevated temperature. Solutions consisting of these uniform particles form only under conditions that are controlled with respect to concentration, pH, rate of heating and aging temperature. The effects of various parameters on the modal particle size, size distribution, relative stability and electrophoretic mobility of the soluble particle is discussed.

32. CHANDLER, J. L.: Advances in the use of synthetic flocculants. In: Light Metals 1976. Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 163-171.

High molecular weight synthetic flocculants have advantages over natural flocculants in the separation of red mud. Because a synthetic flocculant solution is relatively unstable, a new system developed makes and uses it quickly, delivering it to the thickeners by low-shear pumps. Flocculant charge is feedback-controlled at each thickener individually, using photoelectric sensors which follow and record turbidity changes resulting from rake action in the thickener. The turbidity record indicates the flocculant requirement, which is manually controlled but can be computer controlled. The saving in flocculant cost gives a good return on equipment cost. Synthetic flocculation gives high mud compaction with low mud volume and short mud retention time. In the Alcan system, compaction is optimized by using underflow line pressure measurement to control underflow rate. The result is higher washing efficiency and lower soluble caustic loss.

33. CRIADO, E. et alii: Dilatometric characteristics of calcium aluminates. Boletín de la Sociedad Española de Cerámica y Vidro. Vol. 14. No. 3. 1975. pp. 271-273. /Spanish/

The dilatometric behavior of CA , CA_2 , C_3A , CA_6 and $C_{12}A_7$, where $C=CaO$ and $A = Al_2O_3$, is studied on test rods fired at 1200° to $1600^\circ C$ for over 10 hr. Curves for thermal expansion are given. CA_2 shows the smallest thermal expansion coefficient and CA_6 the largest. The variation of the coefficient is a function of the Al_2O_3 content.

34. DENKO, S.: Method and device for waste heat recovery and sand removal in the Bayer process. No. 3,869,537 /4 Feb. 1971/ Official Gazette, 4 Mar. 1975. /U.S. patent/

In the Bayer process for production of alumina by treating bauxite containing monohydrated alumina with an aqueous solution of caustic soda at high temperature and high pressure to form a slurry containing sand, the slurry being subjected to multistage flashing for lowering both temperature and pressure and generating steam, the slurry passing after the flashing through a series of continuous red mud thickeners in counterflow contact with wash water, and recovering alumina and caustic soda contained in the slurry from the overflow liquid from the red mud thickeners, the improvement comprises the steps of introducing overflow liquid from the red mud thickener into a vessel, last stage flashing the slurry in the vessel, bringing the overflow liquid into counterflow contact with the steam generated by the last-stage flashing of slurry within the vessel and effecting heat exchange from the steam to the overflow liquid, forwarding heated overflow liquid back to the thickener and using it as wash water for red mud, discharging slurry from the vessel after flashing at a rate permitting settling of sand particles in a lower section of sand vessel, separately removing sand and slurry out of the vessel.

35. Dissolution of goethite containing bauxite by Bayer method in presence of manganous ferrous, cobaltous or magnesium ions. Fémipari Kutató Intézet. No. DT 2558,411 /24 Dec. 1974/. /German patent/

Dissolution of goethite-containing bauxite by the Bayer method comprises treating of the bauxite with an aluminate lye containing 80-300 g Na₂O /caustic/l with addition of 2-6 wt % Ca compounds calculated as CaO, optionally in the presence of 1-20 g NaCl/l and/or 1-8 g SO₄²⁻/l at 180° to 300° C. The bauxite dissolution is carried out in the presence of 0,3-2.0 wt % of Mn²⁺ /preferably in the form of an oxide-hydroxide manganese ore or Mn impurities in the bauxite/ and/or Fe²⁺ /preferably in the form of FeSO₄ · 7 H₂O or an Fe ore or Fe²⁺ impurities in the bauxite, or partly reduced red mud/ and/or Co²⁺ and/or Mg²⁺ /preferably in the form of calcined magnesite and/or dolomite/. The dissolution is carried out in a tubular reactor. The goethite contained in the bauxite is converted to hematite more rapidly and at lower temperatures than in the known process; the separation of the red mud is facilitated; the loss of caustic soda is reduced.

36. DOJLIVOV, S. P. et alii: Increasing the aluminum hydroxide concentration. Cvetnye Metally, No. 7. 1976. pp. 35-36. /Russian/

In order to increase the precipitation of aluminum, hydroxide tests were made using synthetic high-molecular polymers of the cationic type containing peridinium chloride, beta-, alpha- and gamma-

picolinium chloride, beta-picolinic fraction, quinolinium chloride, lepidinium chloride, quolidinium chloride and isoquinoldinium chloride as flocculants. Of the flocculants tested gamma- and alpha-picolinium chloride were the most active. The gamma form is most effective at a consumption equal to 200 g/ton $Al(OH)_3$. When using the alpha- or gamma-picolinium chloride in concentrating aluminum hydroxide the solids content in the concentrator overflow is reduced and the sedimentation equipment is operated at a faster rate.

37. BREMIN, N. I. et alii: Development of the technology of multiple treatment of bauxites. Izvestija Vyssih Uchebnyh Zavedenij Cvetnaja Metallurgija, No. 6. 1975. pp. 166-167. /Russian/

A pilot industrial trial for a new method of processing red mud is briefly discussed. After heating in a rotating kiln, the sintered mud is melted in an electric furnace to produce cast iron, alumina /leached from slag/ and cement. It was concluded that this two-step process was highly feasible on a commercial level.

38. BREMIN, N. I. et alii: Dissolution of iron in alkaline and aluminate liquors. Trudy VAMI, No. 91. 1975. pp. 10-15. /Russian/

Experiments were made on the leaching of specially prepared sinter of the following molal component ratios: $Na_2O/Al_2O_3 + Fe_2O_3/ = 0.95$ and $CaO/SiO_2 = 1.95$. It was determined that the amount of Fe dissolved into alkaline and aluminate solutions during bauxite leaching from beta- $NaFeO_2$ is a maximum after 1-2 hr and increases with rising alkali concentration and temperature. Almost no Fe from beta- $NaFeO_2$ dissolves in soda solutions. The amount of Fe secreted into the aluminate solution from the sinter does not depend on the Fe content of the sinter.

39. BREMIN, N. I. et alii: Solubility of Na_2CO_3 and Na_2SO_4 in aluminate liquors. Cvetnye Metallurgija, No. 11. 1975. p. 7. /Russian/

The solubilities were studied over a wide range of temperatures and concentrations. For sodium carbonate at a constant temperature and alkalinity, the solubility increases as the Na_2O concentration decreases. For a constant Na_2O concentration and alkalinity the solubility increases with increasing temperature. For a constant temperature and Na_2O concentration the solubility decreases slightly for a decrease in the alkalinity. The composition of the solid phase, regardless of the experimental conditions, is $Na_2CO_3 \cdot H_2O$. For Na_2SO_4 the solubility increases with a decrease in the Na_2O concentration, and with an increase in temperature, the increase being greater with the greater Na_2O concentration. It also increases with an increase in the alkalinity of the solution. The composition of the solid phase depends on the experimental conditions.

40. **BERKMIN, N. I. et alii:** The solubility of sodium salts in aluminate solutions and the composition of the equilibrium solid phases. *Izvestija Vysših Učebnyh Zavedenij, Cvetnaja Metallurgija*, no. 3, 1975. p. 8. /Russian/

The solubility of Na salts in aluminate solutions and the composition of the equilibrium solid phases formed over a concentration range of 100-350 g/l Na_2O within the temperature range 125° to 300° C were studied. The caustic modulus of the solutions was either 1.7 or 3.5. The equilibrium solid phases were found to be $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O} + \text{NaF}$ and $\text{NaF} + \text{Na}_2\text{SO}_4$, the Na_2SO_4 either as thenardite or Type III. If Na_2CO_3 and Na_2SO_4 were simultaneously present in the aluminate solutions, depending on their respective amounts, either berkeite or a solid solution of the berkeite phase of varying composition was formed. The simultaneous interaction of Na_2CO_3 , Na_2SO_4 and NaF in aluminate solutions resulted in a faster rate of formation of the binary salt $\text{Na}_2\text{SO}_4 \cdot \text{NaF}$ than that of berkeite.

41. **ERNST, D. F.:** Aluminum oxide-water system at 25° C and 1 atmosphere total pressure in the 5-13 pH range. *Neues Jahrbuch für Mineralogie Abhandlungen*, Vol. 125. No. 1. 1975. pp. 80-90. /German/

Some 0.1N AlCl_3 solutions were treated with either NaOH or NH_4OH at 25° C to precipitate aluminum hydroxides. The pH was varied between 5 and 13. The hydroxides were examined shortly after precipitation and then after 24 hrs, 3 days and 6 months. Conditions for forming gibbsite, boehmite, bayerite and nordstrandite were identified.

42. **Extracting alumina from mixture-type bauxite.** Sumitomo Chemical Co. Ltd. No. 75 020,040 /5 Nov. 1966/. /Japanese patent./

The Al_2O_3 is extracted by first keeping the alkali solution and mixture type bauxite at 160° to 180° C to dissolve the $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ and increase the desilification of clay-type silica. Then the slurry, an alkali solution and steam are injected into a piston flow-type autoclave and treated at 200° to 250° C. This prevents formation of alkali aluminosilicate scale.

43. **Extraction of alumina from bauxite ores.** Reynolds Metals Co. No. 3,966,874 /14 May 1975/. Official Gazette, 29 June 1976. /U.S. patent/

An improved wet caustic process for the extraction of caustic soluble alumina values from a bauxite containing, on a dry basis, at least 1% by wt of goethite, calculated as FeO/OH , and at least 1% by wt of a monohydrated alumina, calculated as $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$, comprises the steps of: forming a caustic slurry of the bauxite, in a preheating zone, preheating the caustic slurry of bauxite in the absence of a hereafter defined Ca compound and in the liquid phase to a temperature

of at least 200° C; passing the preheated slurry to a digestion zone wherein the slurry is maintained in the liquid phase under digesting conditions of at least 225° C for a digesting time sufficient to dissolve substantially all of the caustic soluble alumina from the bauxite, there being also added to the digestion zone a Ca compound selected from the group consisting of CaO, Ca(OH)₂ and CaCO₃; and removing the resulting slurry from the digestion zone and in a recovery zone recovering the alumina values therefrom.

44. Extraction of alumina from slurry of ore and alkali solution. Sumitomo Chemical Co. Ltd. No. 75 054,099 /7 Nov. 1974/. /Japanese patent/

Method for extracting alumina from ore is designed to prevent deposition of scales on the inner walls of the slurry preheater, to effectively use the heat and to make the maintenance of the preheater more simple. A slurry is introduced into a tubular preheater and heated to a temperature near to the extraction temperature. The slurry is then introduced into a tank for desulfurization, preheated at 130° to 170° C and fed into an extractor after passing through another preheater to extract alumina contained in the slurry. The slurry consists of an ore containing alumina and an alkali solution. The amount of the alkali solution is sufficient to extract alumina contained in the ore.

45. PARKAS F. et alii: Effect of the soda content on the conductivity of aluminate liquors during conductometric determination. Magyar Kemikusok Lapja, Vol. 30. No. 9. 1975. pp. 460-465. /Hungarian/

Na₂CO₃ addition to aluminates increases the conductivity when Na₂O concentration is 45 g/l or less but increases conductivity when Na₂O concentration is over 55 g/l. A soda-independent point, depending on the Na₂O concentration and on the Na₂O/Al₂O₃ ratio, can be determined. These relations were used to establish an on-line automatic analytical system for monitoring the composition of aluminate liquors.

46. FEDJAEV, F. F. et alii: Flotation enrichment of high sulfur bauxites. Izvestija Vyssih Ucebnyh Zavedenij, Cvetnaja Metallurgija, No. 6. 1975. pp. 17-20. /Russian/

Sulfides were removed from bauxite by flotation using soda, copper sulfates, butyl xanthate and pine oil. In this flotation medium it was possible to obtain an alumina product with 0.4-0.6% S. The alumina yield from the product obtained after flotation separation of bauxite containing 6% S was 95.8% and from bauxite containing 2% S was 99.2%.

47. FONSECA, M. C.: Considerations on the structural nature of the aluminate solutions. Pt. 2. Metallurgia, Vol. 28. No. 11. 1976. pp. 618-621. /Rumanian/

The main theories referring to the aluminate solution structure and their limit of applicability in the industrial extraction processes of alumina are presented analytically and synthetically. The theory which explains the separation of the aluminium hydroxide precipitate from solutions, by the forming of the zwitter-ion chains.

48. Gallium by liquid-liquid extraction from ore. Rhone-Poulenc S. A. No. 2530,880 /12 July 1974/. /German patent/

Recovery of Ga by liquid-liquid extraction from strongly basic, aqueous, Bayer process sodium aluminate solution is improved by using an 8-10% solution of 7/5,5,7,7-tetramethyl-1-octen-3-yl-8-hydroxyquinoline /Kelex 100/ in kerosine. The Ga yield can be further improved by addition of 1-decanol to the organic extractant. Gallium is recovered from the organic phase by extraction with a strong HCl solution. Thus, 100 ml sodium aluminate solution, containing Na_2O 166 and Al_2O_3 81.5 g and Ga 240 mg, was extracted with 100 ml solution containing Kelex 100 8 and kerosine 92%. The organic phase contained Ga 148 mg/l, Al_2O_3 and Na_2O 1 g/l. The Ga content of the aqueous phase was 92 mg/l corresponding to a 61,5% Ga yield. If the extraction is done with a kerosine 90 and 1-decanol 10% solution as solvent for Kelex 100, 197 mg/l Ga, corresponding to an 82% Ga recovery, can be obtained in a single stage extraction. In two stages, the Ga yield can be increased to over 99%.

49. Gallium recovery in Bayer aluminum process. Chuo Construction Co., Ltd. No. 75 026,486 /21 Jan. 1969/. /Japanese patent/

The electrochemical extraction of Ga from a circulating alkaline solution in the Bayer process is facilitated by applying a reduction treatment to the circulating alkali solution to remove V, Fe, Cu, Mo or the like, as insoluble metals. After such treatment it is possible to directly electrolytically deposit Ga on a Cu cathode from an alkaline solution which contains Na_2CO_3 18 g/l, SiO_2 0.3 g/l, SO_3 0.15 g/l, P_2O_5 0.8 g/l, V_2O_5 0.5, Ga_2O_3 :0.08-0.23 g/l and As_2O_3 .

50. GOLDMAN, M. M.: Conversion of roasted high-iron bauxite to alumina by the Bayer-sintering process. Trudy Instituta Metallurgii Obgaschenija Akademii Nauk Kazahskoj SSR, Vol. 50. 1975. pp. 23-25. /Russian/

The optimum conditions for leaching calcined bauxites are: 200° C and concentration of circulating Na_2O 200 g/l. Separation of the magnetic fraction from the slime after leaching of the calcined bauxite is effective and involves low losses of valuable components.

This makes it possible to treat high Fe, high-Si bauxites efficiently by the Bayer process. Use of magnetic annealing increases the uniformity of the raw material.

51. GOLDMAN, M. M. et alii: Complexes of trivalent iron in alkaline aluminate solutions. *Izvestija Vyssih Učebnyh Zavedenij, Cvetnaja Metallurgija*, No. 5. 1975. pp. 43-47. /Russian/

Ion complex reactions were studied in $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3-\text{Fe}_2\text{O}_3-\text{SiO}_2-\text{H}_2\text{O}$ solutions at 100°C . Electron spectroscopy, polarography and EPR techniques were used to determine the reaction of trivalent Fe with alkaline aluminate solutions in the formation of complex ions of different compositions.

52. GRIGORIEVA, D. I. et alii: Mechanism of soda regeneration from red muds. *Trudy VAMI*, No. 91. 1975. pp. 47-53. /Russian/

A study was made of the ion exchange material, sodium hydroaluminosilicates, formed during the leaching of bauxites, and of the stability of the products of exchange in weakly alkaline and alkaline solutions containing potassium oxide.

53. KAISHI, N. K.: Elimination of sodium from bayerite. Yoshihisa Otaka, Mitsubishi Chemical Industries Ltd. *Nippon Kagaku Kaishi*, No. 9. 1976. pp. 1492-1494. /Japanese/

The Na content in bayerite was decreased from conventional about 0.7 to about 0.05%. The process included the CO_2 treatment of a concentrated aqueous bayerite slurry about 5 hrs. at 170°C and 40 kg/sq cm in an autoclave. The product was not contaminated and the concentrations of impurities other than Na were negligible. Above 180°C bayerite changed to boehmite.

54. KANAMIROVA, A. A.; NIKOGOSJAN, B. V.: Effect of carbonization depth on the purity of extracted aluminum hydroxide. *Cvetnye Metally*, No. 8. 1976. pp. 44-48. /Russian/

A study was made on the process of total single-stage carbonization without the use of seeding predominantly potassium aluminate liquors of a composition close to the composition of the aluminate liquors used in the complex extraction of nepheline syenites.

55. KATSOBASHVILI, Ya. R. et alii: Aging of amorphous aluminum hydroxide prepared by the carbonation of an aluminate solution. *Zurnal Prikladnoj Himii*, Vol. 48. No. 11. 1975. pp. 2357-2361. /Russian/

The preparation of aluminum hydroxide from solutions containing 50-70 g Al_2O_3 /l by carbonation was studied at pH 10.5 and 11.5. The precipitate obtained at pH 10.5 was an amorphous hydroxide which did not crystallize after 4 hrs. in the mother liquor.

56. KAZAKOV, V. G.; PEVZNER, I. Z.: An exoergic analysis of a thermal system for autoclave leaching of bauxite. Trudy VAMI, No. 88. 1974. pp. 21-34. /Russian/

An exoergic analysis was made of heat and mass transfer in the autoclave leaching of bauxite. In this analysis, the balance of energy, mass and maximum possible work of the substances interacting in the autoclave battery are taken into account. Schematic drawings are shown of the autoclave battery and the heat balance in each local system.

57. KHAZANOV, E. I. et alii: The influence of titanium dioxide on phase transformations and kinetics of sintering of nephelite and urtite with limestone and soda. Izvestija Vyssih Ucebnyh Zavedenij, Cvetnaja Metallurgija, No. 4. 1974. pp. 63-66. /Russian/

A study was made on the effects of TiO_2 and Fe_2O_3 on the sintering of nephelite and urtite bauxites, with and without the presence of limestone and soda. Both ores contained from 26 to 35% Al_2O_3 . As either or both the TiO_2 and Fe_2O_3 content increased, the transformation temperature for liquid phase formation during sintering decreased.

58. KEIL, R. H.: A new method of separating sodium carbonate from Bayer liquors. Aluminum Co. of Canada, Ltd. In: "Light Metals 1976". Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 89-98.

A new process has been developed to maintain desirable sodium carbonate levels in the plant liquors. This process involves cooling of the Bayer plant spent liquor to yield crystals of sodium carbonate decahydrate which can be readily separated from the cold liquor with a subsequent regeneration of caustic soda. Processes for the removal and control of sodium sulphate decahydrate and sodium fluovanadate from spent liquor have also been developed.

59. KONENKOV, T. Ya.: Potentiometric study of the composition of aluminum hydroxy complexes in alkaline solutions. Zhurnal Prikladnoj Himii /Leningrad/, Vol. 49. No. 10. 1976. pp. 2205-2208. /Russian/

The hydrolysis equilibrium of Al^{3+} was studied pH-metrically at $25^{\circ}C$ and ionic strength 3 / $NaClO_4$ /. Formation of polymeric species such as $[Al(OH)_4]_n /OH/_{2/n+2}$ is discussed in view of the discrepancies between previous studies. The nature of the hydrolytic species affects the yield of Al_2O_3 from alkaline solutions.

60. KORCSMÁROS, J.: The kinetics of bauxite digestion. Bányászati és Kohászati Lapok, Kohászat, Vol. 104. No. 5. 1976. pp. 413-419. /Hungarian/

The results are described of tests with which the validity of the results of earlier investigations was checked. The digestion of the

boehmite constituent of bauxite can be accurately defined by the equation for the kinetics of diffusion.

61. KORCSMÁRCS, J.: The kinetics of digestion of minerals containing alumina. *Bányászati és Kohászati Lapok, Kohászat*, Vol. 108. No. 12. 1975. pp. 558-562. /Hungarian/

The mathematical modelling of reactions in the Bayer process is very important for the preparation of computerized process control in alumina production. The relevant research in alumina technology includes reaction kinetics and phase investigations of bauxite, red mud and other intermediary products.

62. KUKOTKINA, T. N.; ILJUVA, G. V.: Development of a process for extracting hydrated alumina from aluminate solutions. *Izvestija Vyssih Učebnyh Zavedenij, Cvetnaja Metallurgija*, No. 4. 1976. pp. 48-51. /Russian/

A method was developed for increasing the rate of extraction of hydrated Al_2O_3 from aluminate liquors by using a special flocculant /containing up to 30% polysaccharides and up to 30% albumin/. Also, optimum flocculant treatment was determined for pulps of different solids contents. The use of the new flocculants increased the clarification rate of hydrate pulps 4-5 times and lowered the solids content in the run off by 2-5 times.

63. LAJUNER, A. I. et alii: Conversion of sodium sulfate by a potassium aluminate solution. *Izvestija Vyssih Učebnyh Zavedenij, Cvetnaja Metallurgija*, No. 5. 1976. pp. 26-30. /Russian/

A process was developed for converting a mixture of potassium and sodium sulfates into pure potassium sulfate by conversion with a potassium aluminate solution. The dependence of the displacement of potassium in solution by sodium from the sulfate mixture on the number of moles of K_2O in the original potassium aluminate solution /unit mole of Na_2O in the original sulfate mixture was studied. Also studied were the effects of various process parameters.

64. LANDI, M. P.; VACCARI, A.: Some technical and economic aspects of alumina extraction from Boko bauxite. *Alumetal Spa. In: Light Metals 1976*. Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 55-88.

While Boko bauxite offers many advantages as compared with monohydrate bauxites, it requires certain precautions in use, due to its peculiar chemical properties. Two different digestion conditions were used for two existing production lines: digestion of 50% of the ore at the relatively low temperature of $170^{\circ}C$ and at low liquor concentration and digestion of the remaining 50% at a higher temperature / $220^{\circ}C$ / and higher concentration.

65. LEITZIZEN, M. G. et alii: Stability of sodium hydroaluminosilicates crystallized from alkali-aluminate solutions. *Izvestija Akademii Nauk SSSR, Neorg. Mater.*, Vol. 12. No. 8. 1976. pp. 1465-1469. /Russian/

With the initial crystallization product in alkaline aluminate solutions of varying composition at $225^{\circ}C$, sodium aluminosilicate of the noseau-type exists which is stable in solution with a low caustic ration in the absence of salts.

66. LEITZIZEN, M. G.; VINOGRADOVA, T. I.: Calculated density of sodium-potassium aluminate solutions at $25^{\circ}C$. *Trudy VAMI*, No. 91. 1975. pp. 128-129. /Russian/

An equation is presented for the density of aluminate solutions, containing sulfates and carbonates, at $25^{\circ}C$. The density is composed of four additive densities, one being that of sodium aluminate solutions containing no salts, the other three being correction factors taking account of K alkali content and the presence of sulfates and carbonates. It was determined experimentally that this equation predicts densities of aluminate solutions to an accuracy of 0.01%.

67. LJAPUNOV, A. N.; DAVIDOV, I. V.: Conditions required for using air mixing during the decomposition of sodium aluminate liquors in carbonators with top-entry gas intake. *Trudy VAMI*, No. 91. 1975. pp. 92-98. /Russian/

A study was made on optimizing the efficiency of an air mixer used in precipitating sodium aluminate liquors in bauxite treatment which had a significant effect on carbonation, that is, it determined the alkali concentration in the gasification zone in the batch process and the caustic modulus in the continuous process. In the continuous process with a top-entry gas intake, it is important to determine experimentally the critical value of the caustic modulus below which low-grade aluminum hydroxide is produced.

68. MAJER, A. A. et alii: Extraction of alumina from Ayat bauxite. *Cvetnye Metally*, No. 8. 1976. pp. 40-44. /Russian/

Pilot scale tests were made on samples of Ayat bauxite and a mixture of Ayat and Turgay bauxites. Previous studies had shown the Ayat bauxite unsuitable for Bayer processing because of high Fe content in the red mud. Results showed that the difference between the theoretical and actual extraction of Al_2O_3 increased with increasing silica modulus in Ayat bauxite.

69. MALTS, N. S.; ZINKEVICH, Zh. D.: Applicability of the decomposition kinetic equation to beta- $2CaO \cdot SiO_2$ in sodium aluminate solutions. *Trudy VAMI*, No. 91. 1975. pp. 22-29. /Russian/

The kinetics of the decomposition of beta- $2CaO \cdot SiO_2$ at $90^{\circ}C$ in an

aluminate solution containing 40 g/l Na_2P were studied. The kinetic data are plotted concurrently with several theoretical curves relating decomposition parameters to time. The results indicate that a self-retarding mechanism accompanies the decomposition reaction.

70. MARJANCSEK, L. V. et alii: Decomposition of ferruginous bauxites by iron sulfate solutions. *Himnija i Tehnologija*, No. 2, 1976. pp. 14-16. /Russian/

To find optimum conditions of leaching of ferruginous bauxites by aqueous $\text{Fe}_2/\text{SO}_4/3$ solutions without free H_2SO_4 , the degree of Al_2O_3 extraction into solution and degree of Fe precipitation were studied by gravimetry in relation to the leaching temperature /100-230° C/, duration of the process /15-180 min/ and $\text{Fe}_2/\text{SO}_4/3$ dosage /80-200% of stoichiometric quantity/ and concentration /100-300 g/cu dm/. Bauxite containing 42.1% Al_2O_3 /38.3% Al_2O_3 in the form soluble in acids/ and 14.6% Fe_2O_3 was used.

71. MATYÁSI, J.: Method for processing bauxites. *Alutary Aluminiumpari Tervező Vállalat: Fémipari Kutató Intézet: Almaszűzítői Tímfoldgyár*, No. 3,944,648 /7 July 1973/. Official Gazette, 16 Mar. 1976. /U.S. patent/

A method for processing goethite-containing bauxite to aluminum hydrate according to the Bayer technology in which bauxite is digested in sodium hydroxide and the resulting material clarified to remove red mud, with an increased yield of aluminum hydrate and with decreased losses of sodium hydroxide.

72. MEDVEDEV, V. V.; LEVINA, T. S.: Favorable limits of limestone additions during the leaching of diasporic bauxites. *Trudy VAMI*, No. 68. 1974. pp. 93-99. /Russian/

Optimum limits of limestone additions during the autoclave leaching of diasporic bauxites with alkali-aluminate solutions were determined. Isotherms of the alkaline modulus and alumina modulus are presented as functions of lime modulus at leaching temperatures ranging from 210° to 280° C. A maximum Al_2O_3 extraction occurred as a function of CaO content, with the maximum being displaced toward lower CaO contents as the leaching temperature increased. At a leaching temperature of 260° C, the Al_2O_3 extracted yield was a maximum /90.5-90.8%/ at a range of CaO content of 3-4.5 wt %.

73. MEDVEDEV, V. V.; MALTS, N. S.: Regularities of scale buildup during the heating of bauxite slurries. *Cvetnye Metally*, No. 7. 1976. pp. 40-43. /Russian/

From a study of the conditions and parameters of boiler scale deposition a qualitative analysis was made of the chemical and phase composition

of the scale forming in the 170-230° C interval as well as the quantitative characteristics of scale formation during the heating of diasporic bauxite slurries. The scale formation rate from bauxite slurries increased with rising temperatures, reaching a maximum at 200-230° C.

74. MEDVEDEV, V. V. et alii: Some characteristics of the digestion of bauxites with a high ferrous oxide content. Trudy VAMI, No. 91. 1975. pp. 61-66. /Russian/

Five different bauxite samples, ranging in Fe_2O_3 content from 19.7 to 26.1% and in FeO content from 1.71 to 7.33%, were digested in alkaline liquors at temperatures of 235° to 285° C for 1.5 hr under laboratory conditions. The total Na_2O content of the liquor was 232 g/l. It was found that ferrous oxide in the form of chlorites may be one of the basic sources of contamination of aluminate solutions during the digestion of Subrovsky bauxites.

75. Method of electrolytically extracting potassium from aluminate solutions. British Aluminium Co. Ltd. No. 3,933,604 /10 July 1973/. Official Gazette, 20 Jan. 1976. /U.S. patent/

76. NEROSLAVSKAJA, L. L. et alii: Effect of ultrasonic vibrations on the precipitation of hydrous sodium aluminum silicate from supersaturated solutions. Trudy VAMI, No. 91. 1975. pp. 82-86. /Russian/

An ultrasonic apparatus was constructed to evaluate the effect of ultrasonics on precipitation of hydrous sodium aluminum silicate /HSAS/ from aluminate solutions saturated with SiO_2 . The temperature of stable nucleation of HSAS crystals over the range 76° to 32° C decreased as a function of ultrasonic frequency /22 to 66 kHz/ and driven oscillator power /15-270 W/.

77. NI, L. P. et alii: Crystallization of cancrinite under low temperature conditions of the Bayer process. Zhurnal Prikladnoj Himii, /Leningrad/, Vol. 48. No. 10. 1975. pp. 2117-2121. /Russian/

At 100° C hydrated sodium aluminosilicate of the cancrinite type is formed under industrial conditions. This process may occur either during leaching /in a solution containing 340 g Na_2O /l and over 30 g K_2O /l/, or during silica removal and concentration /140 g Na_2O /l/ in the presence of organic compounds.

78. NI, L. P. et alii: Influence of turbulent diffusion on thickening of slimes. Izvestija Vyssih Uchebnyh Zavedenij, Cvetnaja Metallurgija, No. 4. 1976. pp. 42-47. /Russian/

The kinetics of slime thickening was studied analytically. The distribution function for the solids concentration along the height of the thickening tank was determined as a function of time in a

gravitational field under conditions of turbulent diffusion. A formula was developed for determining the precipitation limits. By means of the equations given, it is possible to calculate the thickness and average concentration of precipitate for a continuous thickening process.

79. NI, L. P.; ROMANOV, L. I.: Physical chemistry of hydroalkaline methods for alumina production. Alma-Ata, 1975. Nauka, 591 pp. /Russian/

The book is a reference for engineers and research workers engaged in several phases of alumina production, and is based on Russian literature devoted mainly to the processing of low-alumina bauxites and similar ores. Subjects discussed are: review of the existing hydroalkaline methods for processing aluminosilicate ores; structure of low-module aluminate solutions; structure and properties of high-module aluminates; the nature of dissolved impurities in aluminate solutions.

80. NURMAGAMBETOV, Kh. N. et alii: The interaction of components of sinter slimes with alkaline and aluminate solutions. *Izvestija Vyssih Uchebnyh Zavedenij, Cvetnaja Metallurgija*, No. 2. 1976. pp. 71-74. /Russian/

The reactions of mono- and dicalcium ferrites, their mixtures and mixtures with dicalcium silicate in solutions of sinter slimes were studied. The solid phases formed are identified and their physical properties are presented. The absence of dicalcium silicate in products of the treatment of aluminate solutions and the presence of dicalcium ferrite indicated that the silicate decomposed much faster than the ferrite.

81. O'DONNELL, N. B.; MARTIN, W.: The commercial processing of goethitic bauxites from Western Jamaica. Revere Jamaica Alumina, Ltd. In: "Light Metals 1976". Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 135-141.

Operating experiences utilizing Jamaican bauxites with essentially all the iron minerals being in the form of alumino-goethite are described. Considerable expertise was developed both in the study of those bauxites and the translation of technical solutions into operating practice. Two options are available for the processing of goethitic bauxites from Jamaica. The costs of operating at conditions required to promote the conversion of goethite to hematite, whereby an increased availability of alumina occurs against less stringent digestion conditions and increased bauxite to alumina ratios should be compared.

82. PAUKER, V. I. et alii: Processing of high-silicon bauxites. Mineralnogo Syr'a, Vol. 25. 1975. pp. 5-13. /Russian/

The bauxites contained organic impurities, Al_2O_3 50-55, SiO_2 17-20, Fe_2O_3 3-6 and S 2-3%. In one process organic impurities and S were removed by calcining the 3-10 mm grains at 1050°C for 15 min. Then SiO_2 was removed by leaching with a solution of 130 g $\text{Na}_2\text{O}/\text{l}$ at 95°C for 1 hr. A concentrate containing 69.6% Al_2O_3 was prepared with the $\text{Al}_2\text{O}_3/\text{SiO}_2$ ratio 9-10. In a second process a two-component system of bauxite and calcite was heated at 1350°C for 10 min and leached with a soda solution.

83. PESCERSKAJA, N. F. et alii: Mathematical description of the dissolution kinetics of gibbsite in the leaching process Kazakhstan bauxites. Tr. Inst. Metall. Obogashch., Akad. Nauk Kaz. SSR, Vol. 50. 1975. pp. 91-94. /Russian/

The rate of dissolving gibbsite can be described by a differential equation in which the variables are the extraction of Al_2O_3 , the concentration of the intermediate product, the time, the concentration of Al_2O_3 in the NaOH at saturation, the initial concentration of Al_2O_3 in the aluminate solution and the quantity of Al_2O_3 in the bauxite.

84. PETINA, A. P.; LEVINTER, M. S.: Effect of precipitation conditions on the filterability of aluminum hydroxide. Izvestija Vysših Učebnyh Zavedenij, Himija, Himičeskaja Tehnologija, Vol. 18. No. 6. 1975. pp. 1000-1002. /Russian/

The filterability of aluminum hydroxide was optimum when precipitated from an $\text{Al}/\text{NO}_3/3$ solution at pH 7.5 and 50°C . At 40°C pH 7.5 the filtration rate was 0,38 cu m of solution/ /sq m-hr/, corresponding to 230 kg of Al_2O_3 / /sq m-hr/. Tests were conducted at 40° to 70°C with both $\text{Al}/\text{NO}_3/3$ neutralized with NH_4OH and NaAlO_2 neutralized with HNO_3 at pH 7.0-9.5.

85. PEVZNER, I. Z.; ROZEN, Ya. B.: The influence of ionic force of solution on the constant of stability of alumino-silica complexes. Izvestija Vysših Učebnyh Zavedenij, Cvetnaja Metallurgija, No. 4. 1975. pp. 158-159. /Russian/

The state of silica in aluminate solutions was analyzed. The solubility of silica goes through a minimum as a function of the concentration of aluminate ions in $\text{NaOH} + \text{NaCl} + \text{NaAlO}_2$ solutions, and this effect is not completely understood. Two competing aluminosilicate complexing reactions were postulated to explain this effect, and constants characterizing the stability of the complexes in these reactions were determined for solutions at 65°C .

86. PLYGUNOV, A. S. et alii: Study of the mineralogical composition of bauxites from the Vysokopolsku deposit and their slimes after sulfuric acid leaching. *Ukrainskij Khimicheskij Zhurnal*, Vol. 42, No. 5, 1976. pp. 488-493. /Russian/

The purpose of the work was to study the chemical and mineral composition of Vysokopolsku bauxite and the insoluble residue after sulfuric acid leaching with 20, 40, 60 and 80% boiling sulfuric acid solutions. The maximum recovery of aluminium and iron oxides was obtained by leaching with 60% sulfuric acid.

87. Precipitation of aluminium oxide having low sodium oxide content. Aluminum Co. of America, No. 4,014,985 /22 Dec. 1975/. Official Gazette, 29. Mar. 1977. /U.S. patent/

The process of producing an aluminum oxide having a sodium oxide content after calcining of less than 0.1% by weight comprises: continuously precipitating aluminium oxide in a first tank maintained at 55° to 80° C and an alumina-to-caustic ratio of 0.68 while adding feed liquor at an alumina-to-caustic ratio of 1.04 into the tank at a flow rate in litres/minute equal to approximately 0.043% of the volume of the tank.

88. Process for recovering aluminum from alunite. Southwire Co.: National Steel Corp.: Earth Sciences, Inc. No. 3,996,334 /2 June 1975/. Official Gazette, 7 Dec. 1976. /U.S. patent/

A process for recovering aluminum hydroxide from alunite ore comprises: roasting the ore to remove water and leaching the roasted ore with an alkaline solvent or water to remove compounds of S and alkali metals including potassium sulfate resulting in a residue containing Al values and a solution containing potassium sulfate; separating the residue and solution.

89. Production of basic aluminum nitrate solution. Bayer AG. No. 3,983,221 /23 Apr. 1974/. Official Gazette, 28 Sept. 1976. /U.S. patent/

A process for the production of basic aluminum nitrate solutions by reacting metallic Al with nitric acid, comprises establishing a body of metallic Al, supplying additional Al to the body, supplying to the body countercurrent to the supply of the additional aluminum nitric acid of a concentration of 5-30% by wt having basic aluminum nitrate dissolved therein and a pH of about 1-4.

90. PROKOPOV, N. S. et alii: The sintering of red mud mixtures. *Cvetnye Metally*, No. 9. 1975. pp. 39-42. /Russian/

The sintering of red mud mixtures containing various oxides, including silica, Al_2O_3 and Fe_2O_3 , and combustibles was studied. The mixtures were briquetted and sintered at temperatures ranging

from 800° to 1200° C. The cooled sinter was ground and leached in an NaOH solution to extract Al_2O_3 . Increasing sintering temperature from 800° to 1200° C resulted in a gradual increase in Al_2O_3 recovery from 63 to 87.7%. Improved recovery was obtained by compensating for SiO_2 content in the mixture with appropriate levels of soda and limestones.

91. Recovery of sodium aluminate from high-silica aluminous materials. Aluminum Co. of America, No. 3,998,927 /20 Oct. 1975/. Official Gazette, 21 Dec. 1976. /U.S. patent/

In a process for extraction of alumina from highly siliceous aluminous-bearing materials by caustic and lime digest of the materials, the improvements comprise: evaporating the digest solution until the concentration of the solution reaches the composition $Na_2Al_2O_4 \cdot 2.5 H_2O$.

92. RIFDL, I.: Measurement of the solids content in the first two stages of the washing of alumina-plant red mud. *Bányászati és Kohászati Lapok, Kohászat*, Vol. 108. No. 10. 1975. pp. 13. /Hungarian/

The methods for measuring the solids content in the red mud sludge were studied as a function of the concentration of caustic Na_2O and of temperature. It was found that in the range of high sludge concentration / c_1 greater than 350 g/l/ the solid content can be measured by conductivity tests. Plant tests have been carried out with the Oscimho-transmitter for the continuous measurement of the solids content in the sludge fed to the red mud filter.

93. RIFDL, I.: Measuring the solids content in the first two stages of washing of red mud in the alumina plant. *Bányászati és Kohászati Lapok, Kohászat*, Vol. 108. No. 10. 1975. pp. 472-477. /Hungarian/

The methods for measuring the solids content in the red mud sludge were studied as a function of the concentration of caustic Na_2O and of temperature. It was found that in the range of high sludge concentration / c_1 greater than 350 g/l/ the solid content can be measured by conductivity tests. Plant tests have been carried out with the Oscimho-transmitter for the continuous measurement of the solids content in the sludge fed to the red mud filter.

94. RUDASHEVSKY, L. S.; MALTS, N. S.: Method for the mineral engineering evaluation of bauxites. *Trudy VAMI*, No. 91. 1975. pp. 5-9. /Russian/

A nomographic technique was developed for determining the theoretical loss of Al_2O_3 and Na_2O_3 in the Bayer treatment of bauxites. This method makes it possible to predict the efficiency of the leaching process in removing SiO_2 from bauxites of varying mineral

composition. Examples in the use of the nomographic technique are given. Selection of leaching cycles to optimize yield and minimize Na_2O_3 loss can be made by using the nomograph.

95. SAPIEV, A. S. et alii: Study of the kinetics of leaching of highly ferruginous bauxites by sulfuric acid. *Izvestija Vyssin Učeonyn Zavedenij, Himija, Himičeskaja Tehnologija*, Vol. 10, No. 10, 1976, pp. 1555-1556. /Russian/

The kinetics of H_2SO_4 leaching of 0.06-0.5 mm particles of bauxite / Al_2O_3 40.8, Fe_2O_3 24.8, FeO 2.2, SiO_2 3.5, TiO_2 2.2, MgO 0.5 wt %/ at 70° to 100° C in an agitated H_2SO_4 solution indicated that the reaction was kinetic rather than diffusion-limited. The rate of reaction was also affected by the H_2SO_4 concentration.

96. SAKALOTO, K.; KANAHARA, M. et alii: Agglomeration of crystalline particles of gibbsite during the precipitation in sodium aluminate solution. Nippon Light Metal Company, Ltd. In: "Light Metals 1976", New York, 1976. Vol. 2. Metallurgical Society AIME, pp. 149-162.

Under certain precipitation conditions the increase in particle size of gibbsite in seeded pregnant aluminate liquors is largely due to the agglomeration phenomenon of the seed particles and less due to the crystalline growth. An attempt was made to obtain a mathematical model of the agglomeration process based on the initial rate of gibbsite precipitation and the number of seed particles present in the liquor.

97. SCHEPERS, B.: Optimization of the alkaline digestion of bauxites of differing mineralogical and chemical composition. *Erzmetall*, Vol. 29, No. 2, 1976, pp. 61-66. /German/

Rising prices necessitate an optimization of the alumina production process. Bauxites from different deposits are very different in their chemical and mineralogical compositions. The influences of the most important parameters, such as extraction temperature, lye concentration, time at digestion temperature, fineness of grinding and additions of Al, Fe and Si minerals to improve extraction are discussed.

98. Separation of particles from process solutions. VAMI Research and Construction, No. 2360,874 /6 Dec. 1973/. /German patent/

During the treatment of alumina ores with caustic alkalis a complex mixture of sodium and potassium sulfates and aluminosilicates is formed, together with other alkali soluble components in the ore. The slurry so produced can be separated into coarse and fine components by separating the fractions in a hydro separator and taking the heavy fraction via mixer to vacuum filter. This rotates and

passes through a wash cycle before discharge to dump. The fraction still contains 25% of the process solution and this is washed out by water in 1:1 ratio water/solids.

99. SMILES, D. E.: Sedimentation and filtration equilibriums. Separation science, Vol. 11. No. 1. 1976. pp. 1-16.

A theory for describing transient and static equilibrium profiles is presented. The theory is restricted to materials whose particle-size distribution is such that sorting is absent. Equilibrium profiles were calculated for red-mud effluent. Experimental data obtained with red mud are consistent with the theory.

100. SUZUKI, H. et alii: Thermal properties of Hydrated alumina prepared by the homogenous precipitation method. Nippon Kagaku Kaishi, No. 5. 1975. pp. 930-931. /Japanese/

The thermal properties of hydrated alumina prepared by the homogeneous method were compared with those of ordinary hydrated alumina. The latter was a gibbsite as determined by X-ray powder diffractometry and DTA. After heat treatment of 900° C for a long period, the surface area of Al₂O₃ from hydrated alumina precipitated by the homogenous method did not decrease, while that from gibbsite decreased remarkably.

101. SUZUKI, T. et alii: Application of aluminum sludge. Pt. 1. Manufacture of Aluminum Chloride. Nagoya-Shi Kogyo Kenkyusho Kenkyu Hokoku, Vol. 53. 1975. pp. 25-28. /Japanese/

A sludge obtained as a waste from treating the surface of Al metal was used. It contained water 87.7-88.2% and Al₂O₃ 6.2-7.2% and silica and Fe as impurities. A large portion of the silica was removed by evaporating the solution containing HCl to dryness and filtering. The Fe was separated with a strongly basic anion exchange resin.

102. TOKAREV, V. D. et alii: Raising the effectiveness of flotation flocculation clarification of solutions in alumina production. Cvetnye Metally, No. 10. 1976. pp. 36-38. /Russian/

The effects of molecular weight and acetalation of polyvinyl alcohol /PVA/, a flotation flocculant, on its efficiency in aluminate solutions are described. Increasing the molecular weight to 80,000 raised its effectiveness in clarifying aluminate solutions by 5-10% and acidic suspensions by 50-70%. A 15% acetalation of PVA is optimum in clarifying Al(OH)₃ and red mud aluminate solutions. Also, it was demonstrated experimentally that an 0.05-0.075% concentration of PVA is optimum in clarifying Bayer process suspensions.

103. Treatment to make hard calcium aluminate readily crushable and its alumina component leachable. No. 75,153,800 /4 June 1974/. /Japanese patent /
- Molten or solidified calcium aluminate is mixed with at least one of NH_3 , alkali, alkaline earth metal halides and carbonates, heated and blown with at least one of hot air, O , CO_2 , Cl , N , etc. and cooled.
104. TURINSKY, Z. M. et alii: Algorithms for controlling the wet milling operation of bauxite materials under conditions where information on interfering effects is lacking. Trudy VAMI, No. 91. 1975. pp. 135-139. /Russian/
- An algorithm was developed which could be used in automating wet milling operations in alumina production. Based on calculations for the dose limit of recirculated solution in the wet milling of bauxite, limits were determined and are presented for the permissible error in controlling several variables in the process $\text{Al}_2\text{O}_3/\text{Na}_2\text{O}$ ratio, Al_2O_3 and SiO_2 content in bauxite, etc./
105. WEHR, J. et alii: Control of the red mud concentration in the alumina wash-line. Bányászati és Kohászati Lapok, Kohászat, Vol. 108. No. 12. 1975. pp. 563-567. /Hungarian/
- The electrical conductivity and viscosity of mud slurries have been measured in the red mud washing line in an alumina plant. Tests with synthetic solutions have shown that continuous conductivity measurement can be used to monitor the solids content.
106. WEHR, J. et alii: Investigations into the monitoring of the red mud concentration in the washing lines of alumina plants. Bányászati és Kohászati Lapok, Kohászat, Vol. 108. No. 12. 1975. pp. 17. /Hungarian/
- The electrical conductivity and viscosity of mud slurries have been measured in the conditions of the red mud washing line in the alumina plant. Tests with synthetic solutions have shown that continuous conductivity measurement with the Oscimhometer can be used to monitor the solids content.
107. WEHR, J.: Some physical-chemical properties of sodium aluminate solutions. Bányászati és Kohászati Lapok, Kohászat. Vol. 109. No. 3. 1976. pp. 127-135. /Hungarian/
- The density of sodium hydroxyde and sodium aluminate solutions used in the production of alumina and the regression equations expressing density changes are discussed, as well as the molar volume and specific electrical conductivity of the solutions, and the specific electrical conductivity of slurries formed from sodium aluminate solution and dry red mud.

108. YUKHAS, A.: Direction of developments in alumina production by the Bayer method. Trudy VAMI, No. 88. 1974. pp. 141-163. /Russian/
- A historical review is made of developments in the Soviet Union and abroad in alumina production by the Bayer method. Approximately 95% of the world production of alumina is currently made by the Bayer process. The processing of lower-grade bauxites is discussed. Variants in the technology around the world are described.
109. ZAMBO, J.; ORBAN, M.: Formation of calcium oxide and magnesium oxide compounds in the treatment of calcitic-dolomitic bauxites by the Bayer method. Műszaki Tudományok, Vol. 50. No. 1-2. 1975. pp. 233-251. /Hungarian/
- $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3-\text{CaO}-\text{MgO}-\text{TiO}_2-\text{SiO}_2$ solid-solid phase equilibria were determined in synthetic mixtures, bauxites of the Halimba deposit and red muds formed in the Bayer processing of the bauxites.
110. ZHEVNOVATYI, A. J. et alii: Finishing filtration of aluminate liquors through a granular bed. Trudy VAMI, No. 91. 1975. pp. 87-91. /Russian/
- A laboratory study was conducted on the filtration of aluminate liquors through a granular bed of bauxite, muds, lime, coke, alunite etc. to determine the feasibility of replacing sheet filters made of fibers with granular beds. An aluminate solution $[\text{Na}_2\text{O} = 128 \text{ kg/cu m}]$ with 0.1 kg/cu m fine red mud suspended in it was passed through granular bed filters at 20°C to study the efficiency.

2. TECHNOLOGY: NON-BAYER PROCESSES FOR BAUXITE-FEED

111. HES DE HERC, G.: New processes in alumina production. Revue de l'Aluminium, No. 443. Sept. 1975. pp. 397-401. /French/

There exists an affluence of different processes conceived by research workers, however, it seems most obvious to return gradually to the two classical directions in chemistry: the dry or the humid process and the alkaline or the acid one.

112. Gallium and aluminum from bauxite ores. WESTWOOD, W. et alii. Payne, Johnson, Matthey and Co. Ltd. No. 2,530,719 /10 July 1974/. /German patent/

Bauxite is dissolved in NaOH solution under 5 atm pressure at 240° C. Pure Al₂O₃ is separated by cooling and reduction of pressure. The mother liquor is then heated under 20-50 atm pressure of O-enriched air at 150° to 350° C, then Ga is precipitated by cementation on Al chips or wire. The Ga-free aluminate solutions may be recycled.

113. GROJTHEIM, K. et alii: The Alcoa and Toth processes of aluminum production: outline and comparison. 6. Internationale Leichtmetalltagung, Leoben/Wien 1975, 1975. pp. 206-208. /German/

The production of Al from AlCl₃ by the Alcoa and Toth processes is discussed. The processes are compared, and the reaction stages examined from an economic point of view.

114. GRZYMEK, J.: Self-disintegration method for the complex manufacture of aluminum oxide and portland cement. "Light Metals 1976". Vol. 2. 1976. Metallurgical Society AIME, New York, pp. 29-39.

The method described consists in burning in a rotary cement kiln aluminiferous raw material mixed with limestone. The sintered mass separated from 12 CaO.7 Al₂O₃ contains calcium orthosilicate which disintegrates into fine powder of some microns grain size. Alumina contained in this powder is extracted by means of aqueous soda solutions dissolving calcium aluminates in the sintered and disintegrated mass. The postextraction slime of calcium orthosilicate is mixed with limestone to produce portland cement. After desilication of the solution, the sodium metaaluminate decomposed into aluminum hydroxide and sodium bicarbonate. After the aluminum hydroxide is filtrated and desilicated it is calcined to obtain technical grade alumina.

115. JEFFES, J. H. E.; VASANTACREE, V.: Second progress report on recent advances in extraction metallurgy: pyrometallurgy. International Metallurgical Reviews, Vol. 21. Sept. 1976. pp. 128-141.

Physico-chemical data relevant to pyrometallurgy are reviewed and experimental techniques described. The significance of pollution and of fuel costs is discussed with particular reference to the Cu and Al industries.

116. Method for the production of alpha alumina monohydrate. Grace and Co. No. 3,919,403 /17 July 1972/ Official Gazette, 11 Nov. 1975. /U.S. patent/

A process for producing alpha alumina monohydrate having a pore volume of 0.65 to 0.85 cc/g, a pore diam of 95 to 125 Å. and a surface area of 200 to 300 sq m/g comprises: forming an aqueous solution of aluminum sulfate; adding ammonia to raise the pH of the solution to about 2.7-3.5; admixing a compound which will yield ammonia on thermal decomposition in an amount sufficient to raise the admixture to a pH of about 4.5-6.0 after decomposition of the compound; heating admixture to thermally decompose ammonia yielding compound and homogeneously precipitating basic aluminum sulfate; adding a basic compound selected from the group consisting of sodium hydroxide, potassium hydroxide, ammonium hydroxide or sodium aluminate to the admixture, thereby increasing the pH to about 9.0-10.5 and forming alpha alumina monohydrate; and recovering alpha alumina monohydrate.

117. MILLER, J.; IRGENS, A.: Alumina production by the Pedersen process — Possible alternative in Yugoslavia? Rud. Metal. Zb., 1974-1975. No. 2-3. pp. 163-172. /Slovenian/

Over the period of 1928 to 1969, the Pedersen process for the production of alumina was used in Hoyanger, Norway, with an annual production of about 17,000 tons. Recently some preliminary studies of a modern version of the Pedersen process with an annual production of 200,000 tons were made. Based upon practical experience in running a Pedersen process and an available analysis of bauxite from Yugoslavia, material balances over various sections in the process are outlined with a short theory and description of the modern Pedersen process and a presentation of the raw materials. The layout of a smelting test in Norway is included to estimate the quality of the calcium-aluminate slag formed. This test would also include heat and materials balances for the smelting section.

118. PEACY, J. G.; DAVENPORT, W. G.: Comparison among some new methods in aluminium production. *Journal of Metals*, July 1974. pp. 25-28.

Four methods of aluminium production are commented, which seem susceptible to replace the Bayer-Hall-Heroult process, needing high investment, giving little economy in energy and demanding costly equipment to restrict pollution.

119. Production of alumina from ores. Freeport Minerals Co. No. 3,961,030 /12 Aug. 1974/. Official Gazette, 1 June 1976. /U.S. patent/

A process comprises: reacting an Al-containing ore with hydrofluoric acid, fluosilicic acid or a mixture of hydrofluoric and fluosilicic acid, at a 0-10% stoichiometric excess of acid and at a temperature of about 122° to 212° F, to form a slurry containing aluminum fluoride in its liquid phase; separating the liquid phase containing the aluminum fluoride from the solid phase of the slurry; subjecting the separated liquid phase to crystallization to produce crystals of hydrated aluminum fluoride; separating the crystals from the crystallization mother liquor; drying and dehydrating the separate crystals, at a temperature of about 200° to 1400° F to produce aluminum fluoride; pyrohydrolyzing the aluminum fluoride, at a temperature of about 1500° to 2500° F to produce alumina and hydrofluoric acid; absorbing the hydrofluoric acid produced in a first portion of the separated crystallization mother liquor, and recycling the F-enriched mother liquor, washing the separated crystals produced and the separated solid phase of the slurry with water, and recycling the water of the process; and washing the separated solid phase of the slurry with a second portion of the separated crystallization mother liquor, and recycling the mother liquor to the first step of the process.

120. Pure aluminum oxide. Hyman M. Lowenstein and Arthur M. Lowenstein, No. 2440,329 /31 Aug. 1973/. /German patent/

An Al-containing mineral is treated with concentrated H_2SO_4 in a two-stage process: first, a mixture of the mineral and the acid is heated to 190° to 250°C to convert the Al to $Al_2(SO_4)_3$ and to drive off the H_2O ; then C is added to the mixture which is heated to 700° to 800° C to remove the H_2SO_4 as SO_2 and SO_3 . The SO_2 and SO_3 are being absorbed and worked up to H_2SO_4 which is recycled. The reaction product is ground to a fine powder, dissolved in an aqueous NaOH solution and filtered to remove impurities. Upon seeding of the filtrate the $Al(OH)_3$ is precipitated, filtered, washed and dried at 105°C. Calcination at 1200°C results in a pure Al_2O_3 .

121. SHELTON, R. A. J.: Second progress report on recent advances in extraction metallurgy: chloride process metallurgy. International Metallurgical Reviews, Vol. 21. Sept. 1976. pp. 141-147.

Developments in chloride process metallurgy are reviewed with reference to the TORCO process for the extraction of Cu, the recovery of Sn from low-grade concentrates, the upgrading of ilmenite, the treatment of Pb-Zn concentrates and slags, and the beneficiation of chromite. Processes employing chlorination for the recovery of U, Ni and Zr are considered, and methods for extracting metals from chlorides are described with particular reference to the Toth process for Al.

3. TECHNOLOGY: THE PROCESSING OF NON-PATHOLOGIC RAW MATERIALS

122. ABD ELKARIM, O. I. et alii: Recovery of alumina from nepheline by dissolving in acid. *Sprechsaal für Keramik, Glas, Baustoffe*, Vol. 108, No. 15/16, 1975, pp. 426-430. /German/

Synthetic nepheline and albite were produced from Na_2CO_3 , SiO_2 and Al_2O_3 and subjected to microscopic and X-ray analysis methods. Their relation within the ternary systems was discussed. Al_2O_3 was removed from the nepheline by low-concentration acids but inorganic acids did not attack albite. With high concentrations inorganic acids alumina recovery from nepheline was decreased.

123. Alumina and alkali from nepheline production using lime-sulfur-chromium fusion method giving nonhygroscopic cake. *Aluminium, Magnesium Electr. Ind. Re. Inst.* No. 485,420 /21 Jan. 1974/. /Soviet patent/

The title products are prepared from nepheline /low Fe/ and red slime /high Fe/, which involves heating with lime or limestone in the presence of S and Cr compounds. The ferrite-aluminate components of the resultant cake are stabilized, and product yields improved, by using $\text{K}_2\text{O}:\text{Fe}_2\text{O}_3 + \text{SO}_3 + \text{CrO}_3$ in 0.2-1.1 ratio while cake hygroscopicity is reduced by keeping $\text{SO}_3:\text{Al}_2\text{O}_3 = 0.05-0.2$.

124. Alumina preparation by carbonating aluminate solutions from nephelines using a constant neutralization rate and temperature drop. *Irkutsk Aluminium Works*, No. 506,576 /20 Feb. 1973/. /Soviet patent/

$\text{Al}(\text{OH})_3$ is made from aluminate solutions, ex nepheline treatment by carbonation with Na_2CO_3 solution. The process is accelerated and solutions of medium Si-content can be employed, by carbonating at a constant neutralization rate of 6-12 g/l Na_2CO_3 /hr, while the process temperature is simultaneously lowered from 80° to 70° C. Both Na_2CO_3 and CO_2 are used in the carbonation process.

125. Aluminum and aluminum oxide. *Jerzy Gdynia. Chemik*, Vol. 29, No. 7, 1976, pp. 231-233. /Polish/

A plant for the preparation of Al_2O_3 from clay is discussed. The clay is calcined with limestone and the Al^{3+} is extracted from the calcinations product. The residue is used in conjunction with other raw materials for manufacturing cement. By this method 4.5 - 5.0 tons of CaCO_3 are saved in the cement plant/ton of Al_2O_3 manufactured and the productivity of the cement mill is increased 20-30%.

126. ARAVAMUTHAN, V. et alii: Laboratory scale studies on the extraction of aluminum oxide suitable for the production of high-grade fused alumina from Neyveli fly ash and Sivaganga clay. In: "Proc. Semin. Electrochem., 14 th", Karaikudi, India, 1974. Cent. Electrochem. Res. Inst. pp. 141-146.

High-grade Al_2O_3 was extracted from Neyveli fly ash and heat-treated Sivaganga clay by leaching at $50^\circ C$ with mineral acids like HNO_3 , precipitation of hydroxides of Al and Fe with liquor NH_3 and subsequent treatment with 20% NaOH to obtain sodium aluminate followed by separation of the hydroxides or by using $(NH_4)_2SO_4$ in a cyclic process. Al_2O_3 and Fe oxide are finally prepared by heating the hydroxides at $800^\circ C$ for 1 hr. The Al_2O_3 has 98-99% and above grade of purity and is suitable for the production of high-grade fused Al_2O_3 by electrothermal procedures.

127. ARLJUK, B. I. et alii: Effect of the concentration of the aluminate liquor on the leaching process of nephelite sinters. Cvetnye Metally, No. 2. 1976. p. 11. /Russian/

Alumina recovery increased 3-4% during digestion of Achinsk alumina combine cake with a decrease of the caustic modulus, α_k from 1.6 to 1.3-1.4, for solutions containing 15 g/l sodium carbonate, while a further α_k decrease had only a slight effect. Recovery also increased by 1-3% as the alkali carbonate content increased from 5 to 15-25 g/l.

128. ARLJUK, B. I. et alii: Effect of the concentration of the aluminate solution on the process of digesting nepheline cakes. Cvetnye Metally, No. 2. 1976. pp. 43-47. /Russian/

Alumina recovery increased 3-4% during digestion of Achinsk alumina combine cake with a decrease of the caustic modulus, α_k from 1.6 to 1.3-1.4 for solutions containing 15 g/l sodium carbonate, while a further α_k decrease had only a slight effect. Recovery also increased by 1-3% as the alkali carbonate content increased from 5 to 15-25 g/l.

129. ARLJUK, B. I. et alii: Study of the rheological properties of alumina mixtures. Trudy VAMI, No. 88. 1974. pp. 35-47. /Russian/

The viscosity and flow resistance of bauxite pulps were determined as a function of moisture content. It is advantageous, in sintering these pulps, to maintain the lowest possible moisture content in a rotating kiln to minimize fuel costs. A correlation was made between rheological properties and the technology of treating the raw materials in rotating kilns.

130. ARLJUK, B. I. et alii: Washing bellite mud on carousel filters. Cvetnye Metally, No. 10. 1975. p. 8. /Russian/

Thickener-filters have been used in the alumina industry for leaching nephelite sinters in order to separate the ballite /nephelite/ mud from the aluminate liquor. At the Achinsk Alumina Complex, carousel filters with a filtration surface of 60 sq m were used to filter and wash the mud.

131. BAKR, M. Y.; MONKM, N. M. A.: Extraction of alumina from Egyptian nepheline-syenite. Pt. 11. Sintering and Leaching. Silikat Journal, Vol. 15. No. 2. 1976. pp. 64-66.

The lime-soda sinter process is described for the production of high-grade Al_2O_3 from Egyptian nepheline-syenite igneous rock. Sintering is conducted at $1100^{\circ}C$ for 1.5 hr with CaO/SiO_2 ratio 2.0 and Na_2O/Al_2O_3 ratio 1.2. Leaching is done with dilute Na_2CO_3 solution at $70^{\circ}C$ for 20 min with mechanical stirring.

132. BANDART, G. D.: Alumina without bauxite. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 57-66. /French/

The economic and technical justification for the development of extraction processes for Al ores other than bauxite is considered. Increasing demand may result in exhaustion of bauxite reserves in 40-50 years. Non-bauxite processes which have been operated are enumerated. The gradual development of new sources and processes may be accelerated by unjustified increases in bauxite prices.

133. BAUDART, G. A.: Aluminium in France. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 67-69. /French/

Aluminium Pechiney and Alcan will participate in equal parts in the construction and exploitation of a pilot plant near Marseille for producing 20 tons daily of high quality aluminum based on the H^+ ...process developed by Aluminium Pechiney one years ago.

134. BAUDART, G. A.: Alumina without bauxite. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 61-64. /French/

The classic bauxite deposits are by no means inexhaustible and the effective rises in the price of bauxite are of such magnitude that a reviewal of the overall problem becomes necessary in itself. Already now recent technological developments of processes such as the H^+ process and the comparative economic studies to which they have been submitted evidence that in respect of a certain number of new projects, the decision tips in favour of the new routes using other ores instead of bauxite.

135. BAUDART, G. A.: Aluminium in Bulgaria. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 67-69. /French/

According to the Bulgarian minister of mining, one of the priority tasks ought to be the production of oil from bituminous deposits, estimated to about 4 milliard tons. The residues of these deposits contain after oil extraction about 20% alumina and are intended to be utilized as prime material for the aluminium industry. Another raw material to be used is bulgarite /5 million tons/, containing besides aluminium also potassium /kalium/, vanadium, gallium and iron. In addition, the aluminium industry can also utilize the ash of lignites produced in heating power stations.

136. BAUDART, G. A.: Aluminium in the Federal Republic of Germany. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 67-69. /French/

The VAW /Vereinigung der Aluminiumwirtschaft/ is studying - similar to other aluminium producers - possibilities for replacing bauxite by clays; the Federal Republic of Germany disposes of exploitable clay-deposits suited for aluminium production. However, according to Dr. Bielfeldt, one of the leading personalities of VAW, aluminium production from other basic materials than bauxite, will only gain moment in the 1980-s.

137. BERSHTEIN, Ya. A.; SHMORGUNENKO, N. S.: Problems of manufacturing alumina from non bauxitic ores in the world aluminum industry. Trudy VAMI, No. 81. 1971. pp. 148-170. /Russian/

The processing of low grade ores to produce Al is reviewed. Statistics on world-wide production of Al are presented and discussed. Several new processes for producing alumina from low-grade ores are reviewed: nitric and sulfuric acid leaching /Soviet developments/, the production of alumina from Mexican alunite ores, and a new Polish method for the simultaneous production of cement and alumina.

138. BLISS, N. J.: Non-bauxite sources of alumina: a survey of Canadian potential. Canadian Mining and Metallurgical Bulletin, Vol. 69. No. 774. Oct. 1976. pp. 75-85.

Of the three igneous rocks that have been used as a source of alumina, only anorthosite is considered as a potential source in Canada. The Al content would be extracted by a sinter process, which currently requires a raw material with a minimum of 28% Al_2O_3 . Thus, about 4 tons of anorthosite and 10 to 12 tons of limestone are needed to produce one ton of alumina.

139. BYKOV, A. D.: Disruption of stoichiometry in natural alunites. Trudy VAMI, No. 81. 1971. pp. 15-23. /Russian/

Variations between expected and actual stoichiometric chemical components $/\text{H}_2\text{O}, \text{Na}_2\text{O}, \text{Al}_2\text{O}_3, \text{SO}_3, \text{SiO}_2, \text{Fe}_2\text{O}_3, \text{and R}_2\text{O}/$ in natural alunites are discussed. Calculations of various chemical species of different alunite ore samples were made; these contained 42.5-43.1% alunite. It was found that the alunite in the ore samples contained 7.52% H_2O /instead of 11.00% by stoichiometry/, 0.27% Na_2O /instead of 0.40%/, and 7.59% R_2O /instead of 11.00%/. This alkaline deficiency can make alumina extraction uneconomical.

140. CAVIN, D. C.: Study of iron and aluminum recovery from power plant fly ash. Apr. 1974. Ames Lab. 121 p.

A study of Fe and Al recovery from power plant fly ash was performed to characterize a particular fly ash as a potential source of Fe and Al. Magnetic separation of the Fe-rich particles provided a fly ash fraction amenable to further Fe extraction processes. Sulfuric acid leaching of the whole sample of fly ash as well as the fines $/-200$ mesh/ showed a decrease in Al extractibility at increasing acid strengths.

141. CHOU, K. S. et alii: Lime-sinter process for production of alumina from fly ash. In: "Fourth International Ash Utilization Symposium" 1975. Ames Laboratory, 19 p.

A substantial background of literature on methods of extracting alumina from aluminous-siliceous raw materials shows that alumina may be released by addition of calcium oxide /lime/ in a high-temperature treatment to produce a sinter or slag from which alumina is extracted using a sodium carbonate solution, the silica being converted to dicalcium silicate. The calcium oxide has a stronger affinity for silica than does alumina, thus leading to release of the alumina for extraction.

142. CHULL HYUNG CHO, et alii: Manufacture of alumina from the residue yielded during the treatment of alunite with ammonia. Hwahak Konghak, Vol. 13. No. 3. 1975. pp. 11.

Potash-ammonia fertilizer $/\text{K}_2\text{SO}_4 \cdot \text{NH}_4/2\text{SO}_4/$ is prepared from the uncalcined alunite treated with NH_4OH . The residue containing a large amount of alumina and treated by an alkali solution may be regarded as a source of high-purity alumina. The residue contains alumina 45-50, silicate 25-30, and moisture and Fe 10-15%.

143. COHEN, J.; MERCIER, H.: Acid treatment of non-bauxitic ores for the production of aluminum -- The H⁺ plus process. Annales des Mines, Vol. 182. No. 7. 1975. pp. 49-56. /French/

The H⁺ process consists of successive treatments of the ores with concentrate H_2SO_4 and HCl, separation of impurities, crystallization

of sulphate and chloride and treatment of the sulfate and chloride to yield high-purity Al_2O_3 . The steps in the process as applied to carboniferous schist and clay are explained by schematic diagrams.

144. COHEN, J.; MERCIER, H.: Acid treatment of non-bauxitic ores for the production of aluminium -- the H plus process. *Annales des Mines*, No. 5. 1976. pp. 49-56. /French/

After discussing the distribution and limits of world bauxite reserves, other possible ores of Al are considered. The H⁺ process developed by Aluminium Pechiney is described which, after successive treatment with sulfuric and hydrochloric acids on schists and clay gives an alumina of a higher purity than that of the Bayer process. An experimental unit capable of treating from 70 to 100 tons of ore/day is to start operating in May-June 1976, to produce 15 to 20 tons calcined alumina/day.

145. COHEN, J.; MERCIER, H.: Recovery of alumina from non-bauxite aluminum-bearing raw materials. Aluminium Pechiney. In: "Light Metals 1976". Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 3-18.

A process described permits the recovery of alumina from non-bauxite ores. The H⁺ process allows the recovery of alumina contained in the silicoaluminous ores such as clays, shales and coal shales by selective dissolution of alumina in a concentrated H_2SO_4 solution which avoids the preliminary roasting of the ore and conversion of aluminum sulphate into chloride and efficient purification of alumina in the form of aluminum chloride hexahydrate.

146. Complex processing of alunite. Aluminium, magnesium. *Elect. Ind. Re. Inst. No. 484,185* /28 Sept. 1977/. /Soviet patent/

A method for complex processing of alunite into Al_2O_3 , H_2SO_4 , K_2SO_4 , consisting of heating and reduction of alunite by elemental S, leaching of reduced alunite with a mother liquor, removal of Si, evaporative concentration of the aluminate solution and conversion of sulfate salts with a solution of KOH is different because of the simplicity of the process. Molten S is used at 140° to 180° C and the reduced alunite is leached in the hot state.

147. CONSTANTINESCU, I. Gh. et alii: Possibility of recovering the aluminum in coal ashes. *Bul. Inst. Politeh. "Gheorghe Gheorghiu-Dea" Bucuresti*, Vol. 37. No. 1. 1975. pp. 21-32. /Rumanian/

The lignite used as fuel in Rumanian thermoelectric plants containing about 40% ash leaves 4 . 10⁶ ton/year of inorganic residue, containing SiO_2 40.2-50.2, Al_2O_3 25.7-51.2, Fe_2O_3 4.4-11.4, CaO

0.60-0.70 and Fe_2O_3 0.31-0.44%. The maximum Al_2O_3 recovery, 87%, was obtained experimentally by heating the ash at 250°C , for 15 min. with a 500 g NaOH/l solution at a $\text{Na}_2\text{O}:\text{Al}_2\text{O}_3$ ratio = 40.

148. DEBENTSKAYA, S. D. et alii: effect of the proportions of sodium oxide and calcium oxide on the sintering of high-silicon aluminum ores. *Himijska i Tehnologijska, Kiev*, No. 1. 1976. pp. 3-5. /Russian/
- With article from the Kiya Shaityrsk deposit the recovery of Al is increased and the sinter is more porous if the ratio of alkali and alkaline earth oxides to acidic oxides is adjusted to 0.95-0.90 by the addition of CaO for partial binding of Al_2O_3 as a calcium aluminate. Also, the quality of process of the portland cement is improved.
149. Digging for alumina processes. *Chemical Week*, Vol. 114. No. 10. 6 Mar. 1974. p. 40.
- Aluminum producers are evaluating new processes that can exploit reserves of Al-bearing materials other than bauxite. The processes include extracting Al_2O_3 from shales and clays, nitric acid treating of clays such as alunite and dawsonite, alunite processing by a modified Bayer approach and treating clay with H_2SO_4 and subsequently with HCl /H-plus process/. The H-plus approach will process clays with as little as 18-20% Al_2O_3 .
150. GINZBERG, D. L. et alii: Separation of potassium sulfate during the complex treatment of nephelines. *Himijskaja Promyslennost'*, No. 3. 1976. pp. 229-230. /Russian/
- Two procedures for two-stage soda separation are compared, one with and the other without interstage separation of K_2SO_4 from solutions. For $\text{K}_2\text{SO}_4:\text{Na}_2\text{CO}_3$ weight ratio /M/ 0.025 the former procedure was more effective and for M = 0.05 the latter was more effective. For M = 0.04 both procedures were equally effective.
151. GOODBOY, K. P.: Investigation of a sinter process for extraction of Al_2O_3 from coal wastes. Aluminum Co. of America. In: "Light Metals 1976. Vol. 2. New York 1976. Metallurgical Society AIME, pp. 19-28.
- Sinter reaction chemistry for extraction of Al_2O_3 from high ash coal waste from a coal beneficiation plant is discussed. When S is present, conventional lime sinter chemistry does not apply. Instead, $4\text{CaO}\cdot 3\text{Al}_2\text{O}_3\cdot \text{SO}_3$ forms rapidly and leaches readily. The major factor causing loss of Al_2O_3 extraction is formation of $4\text{CaO}\cdot \text{Al}_2\text{O}_3\cdot \text{Fe}_2\text{O}_3$ which has a relatively slow leaching rate.
152. GUNNITSKAJA, N. O.: Approximate mathematical model for the agitative leaching of finely ground nepheline sinter. *Visn. L'vov. Politekn. Inst.*, Vol. 95. 1975. pp. 165-167. /Ukrainian/

The kinetics of sodium aluminate leaching from nepheline sinters with particle sizes 1.0, 0.5, 0.25 and 0.04 mm was investigated at 40-90° C. The Experimental results agree with the predictions of a theoretical model which assumes that internal diffusion is the rate-determining step in the leaching process.

153. HABLO, L. M. et alii: Kinetics of thermal decomposition of synthetic alunites. Ukrainskij Himičeskij Žurnal, Vol. 42. No. 5. 1976. pp. 494-499. /Russian/

A thermogravimetric study was done on the kinetics of thermal decomposition of $R_2[Al_6SO_4/4/OH/12]$, where R is Na^+ , K^+ or NH_4^+ . These synthetic alunites were made in autoclaves from $Al_2/SO_4/3$ solutions in which $R_2SO_4:Al_2/SO_4/3 = 1:3$ and $Al_2O_3:SO_3 = 0.75$. Values of activation energies and the kinetic parameter for the dehydration stage of decomposition are tabulated, based on different calculation methods.

154. HA-GOL, KIM, et alii: A study on dehydration of Paegam alunite. Hwahak Kwa Hwahak Kongop, Vol. 18. No. 5. 1975. pp. 237-241. /Korean/

Dehydration properties of Paegam alunite produced in North Korea are studied from the kinetic aspect to produce alumina, sulfuric acid and potash fertilizer. The dehydration rate of Paegam alunite is 80-90% at 520° to 540° C for 25-50 min, and at 540 to 560 C for 15-20 min.

155. HEE CHUL LEE, et alii: Heterogeneous reaction of calcinated alunite powder with ammonium buffer solution. Taehan Hwahak Hoechi, Vol. 19. No. 5. 1975. pp. 381-385. /Korean/

Alunite, $KAl/SO_4/2Al_2O_3$, 150-250 Tyler mesh size, was calcined at 580° C and the calcined sample /surface area 5100 sqcm/g/ was used to study the kinetics and reaction mechanism of the extraction reaction of K and Al with an ammonium buffer solution, pH = 8.0. The kinetics of the reaction follow Jander's equation. The rate constants increase with the amount of solid and temperature of the reaction system.

156. IENCIU, M. et alii: Experimental research concerning the processing of indigenous bituminous schists with hydrochloric acid in order to obtain aluminum oxide. Pt. 1. Revista de Chimie, Vol. 27. No. 6. 1976. pp. 494-498. /Rumanian/

A mathematical expression derived for the dissolution kinetics of the bituminous schists in dilute HCl proved that the rate depended on temperature, the diffusion of the reagent, the particle size and the form of the particles, which was confirmed experimentally.

Thermogravimetric analysis of the schists, consisting of the aluminosilicates kaolinite, halloysite and montmorillonite, proved that the highest Al_2O_3 recovery would be obtained by calcination at 650° to 750° C for 2.5-3 hr.

157. IBNCIU, L. et alii: Experimental research on the processing of indigenous bituminous schists with hydrochloric acid for aluminum oxide production. Pt. 2. Revista de Chimie, Vol. 27. No. 8. 1976. pp. 664-667. /Rumanian/

Al_2O_3 was extracted with HCl from calcined oil-shale. The best yields were obtained by calcination at 650° C for 3 hr and extraction with 20% HCl for 3 hrs. at 98° C.

158. KAMPHAUSEN, D.: Alternatives to the production of aluminum oxide from bauxite -- the example of the USSR. Metall, Vol. 31. No. 1. Jan. 1977. pp. 92-95. /German/

Processes for obtaining Al_2O_3 from nepheline or alunite are briefly outlined. These processes should cause no environmental pollution such as the red mud produced in extraction from bauxite. In the processing of nepheline, besides Al_2O_3 , Portland cement, soda, potash and Ga are obtained. The process can be varied to produce grades of Al_2O_3 suitable for grinding and polishing purposes. In the processing of alunite the end products are essentially Al_2O_3 , K_2SO_4 , V_2O_5 and Ga.

159. KHAKIMOV, S. A.; KOSTENKO, A. S.: Effect of certain impurities on the dehydration of alunites. Himija i Tehnologija, Kiev, No. 4. 1975. pp. 10-12. /Russian/

The rate of dehydration of alunite and alunite concentrations /73% in the presence of additives, such as kaolin, hydrated iron oxides and SiO_2 , at 100 to 1000° C was measured by using thermogravimetric analysis and DTA. The mixture of alunite concentration nine parts and kaolin one part had the maximum dehydration rate.

160. KHOROTYAN, V. A. et alii: Production of calcium metasilicate hydrate. In: "Mater. Konf. molodykh Uch. Spets., Akad. Nauk Arm. SSR". Yerevan, USSR, 1976. Akad. Nauk. Arm. SSR. pp. 49-56. /Russian/

In the production of alumina by complex alkaline treatment of nepheline syenite ores, $\text{CaO} \cdot \text{SiO}_2 \cdot \text{H}_2\text{O}$ is obtained as a by-product. Other products are sodium metasilicate, calcium metasilicate, erivanite, etc. The $\text{CaO} \cdot \text{SiO}_2 \cdot \text{H}_2\text{O}$ was obtained by caustification of alkali silicate solutions with lime at 80° C.

161. KORNEEV, V. I.: Complex processing of nepheline sludge. In: "Kompleksn. Ispol'z. Syr'ya Tekhnol. Vyaznushchikh Veshchestv", Leningrad, 1973. Tekhnol. Inst. Leningrada, pp. 3-10. /Russian/

Recent methods of utilizing nepheline sludge /wastes from Al_2O_3 production/ consist mainly in its use as a constituent in mixtures for producing portland cement or mixed binders. A brief review is given of the possible use of these wastes; manufacture of refractories and glass, the foundry industry for casting, the production of sorbents for purifying effluents from trace amounts of metal ions, agriculture for mining acid soils, hydrated silicates and SiO_2 production, fillers in the plastics, paints, paper etc., road building, and as a constituent of asphalt-concrete, as well as for the production of special materials of silicate brick type.

162. KOZHEVNIKOV, G. N.: Cheaper decomposition of alumina-containing ores. No. 458,511 /17 July 1964/. /Soviet patent/

The ore is hydrochemically treated to give sodium-aluminate which /after drying/ is then reduced by Al_4C_3 by the scheme: $9 \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 + \text{Al}_4\text{C}_3 = 18 \text{Na} + 11 \text{Al}_2\text{O}_3 + 3 \text{CO}$ at 1100 to 1300°C under 1-40 mm Hg pressure. The Na metal is condensed and ready for use /yield 350 kg Na/ton ore/. The alumina is reduced with C to give Al.

163. LAINER, A. I. et alii: Study of the process of calcined and reduced alunite dust in counterflow streams. *Izvestija Vyssih Učebnyh Zavedenij, Cvetnaja Metallurgija*, No. 6. 1975. pp. 51-53. /Russian/

Particle motion and the change of concentration of particles in a colliding gas stream containing alunite dust were studied. In this agglomeration technique, two axisymmetrical dust-laden streams are wet with a liquid /usually water/ and forced to collide so that the particles agglomerate. Dust from calcined furnaces agglomerated more effectively than dust from reducing furnaces.

164. Leaching of ore under pulsating condition. *Aluminum, Magnesium, Electr. Ind. Re. Inst.* No. 500,184 /22 May 1974/. /Soviet patent/

Alunite is leached at 20° to 40° C for 10-30 min in a vertical ore stream with simultaneous transverse pulsation.

165. *London Metal Forum*, Oct. 1975. *Metal Bulletin*, No. 6037. 31. Oct. 1975. pp. 25-26.

Pechiney, in a joint program with Alcan, is constructing a pilot plant near Marseilles to test the technical and economic feasibility of its H-Plus Process for producing Al_2O_3 from non-bauxite raw materials /such as clays and shales/ using H_2SO_4 and HCl. The plant will produce 20 tons/day and be in operation in 1976. By 1979 sufficient data are expected to assess accurately the feasibility in a full-scale industrial application. The Al_2O_3 quality will be generally higher than for the Bayer process.

166. MELNICHENKO, A. S. et alii: Thermodynamic analysis of reactions in the nepheline-calcium oxide system. *Žurnal Vsesojuznogo Himičeskogo Obcestva*, Vol. 21. No. 2. 1976. pp. 226-227. /Russian/
- Thermodynamic calculations were performed for 16 possible reactions occurring in the system nepheline $Na_2O \cdot Al_2O_3 \cdot 2SiO_2$ /I/ + CaO at 600° to 2000° K assuming standard enthalpy, entropy and heat capacity of I to be -999.2 kcal/mole, 58.0 cal/mole-degree and 60.9 cal/mole-degree, respectively. At over 1100° K, only the reactions producing $CaO \cdot Al_2O_3$ and $Na_2O \cdot 2SiO_2$ are thermodynamically possible.
167. Method of treating alunite ore. Southwire Co., National Steel Corp. and Earth Sciences Inc. No. 3,390,426 /21 Mar. 1974/. Official Gazette, 17 Jun. 1975. /U.S. patent/
- A method for recovering aluminum hydroxide from ore containing alunite comprises the steps of: roasting the ore to remove the water of hydration, leaching the roasted ore with a weak base at a pH of from about 8-12 to dissolve sulfate and alkali metals, separating the liquid and solid portions of the slurry resulting, the liquid portion containing dissolved sulfate and alkali metals, digesting the solid portion with an aqueous mixture of alkali metal hydroxides.
168. MONASHKOV, V. V. et alii: Heat consumption of nepheline charges. *Trudy Vsesojuznogo Naučno-Proektnogo Instituta Alyumino Magnievoj Elektrodoj Promyslennosti*, Vol. 85. 1973. pp. 102-106. /Russian/
- The results are presented of experimental determination of heat consumption of basic nepheline charges at 100° to 1300° C. The data on heat consumption were determined by the relative method of constant heat flow based on the use of a diathermic shell. This shell was calibrated by using materials possessing similar heat consumption-temperature reactions as the nepheline charges, that is MgO , Al_2O_3 , CaO and $CaO + CaCO_3$ mixtures. A graphical method of evaluation of the experimental data was proposed.
169. NIKOGOSYAN, R. B. et alii: Nepheline transformations during treatment with a sodium hydroxide solution containing various amounts of silica. In: *Konferenciya Molodyh Učennih Specialista Akademii Nauk Armianskoj SSR, Jerevan, USSR, 1973. Akad. Nauk Arm. SSR. pp. 7-15. /Russian/*
- Nepheline containing SiO_2 42.8, Al_2O_3 32.06, Fe_2O_3 1.86, K_2O 0.27 CaO 0.75, MnO 0.38, Na_2O 14.7, K_2O 7.0 and P_2O_5 0.28% was treated at 240° C for 1 hr with a 30% NaOH solution. The liquid solid ratio was 5:1. Part of the mineral remained solid. The other solid phase was a basic sodalite, $Na_2O \cdot Al_2O_3 \cdot 2SiO_2 \cdot 0.5NaOH \cdot H_2O$.

170. Norway: alternative to alumina? Mining Journal, Vol. 288, No. 7388. 25. Mar. 1977. p. 226.

A new company, Anortal, has been established by Ardal og Sunndal Verk and Elken Spigerverket to investigate development of anorthosite reserves at Aurland/Voss in West Norway.

171. NOWAK, Z.: Iron and alumina extraction from power plant fly ash in Poland. In: "Third International Ash Utilization Symposium", Pittsburgh, 1973. pp. 224-230.

In Poland a power plant fly ash is regarded as a source of raw material for industrial production of artificial magnetite and alumina oxide. Methods of extraction of both the minerals are described and flowsheets shown. Characteristics of the magnetite product are given. The actual magnetite production is entirely used for dense medium preparation in coal cleaning processes. For alumina oxide extraction two Polish methods are being discussed.

172. OPRKA, F. et alii: Sintering in reducing medium of alumina-containing batches. Cercet. Metal., Bucharest, No. 16. 1975. Inst. Cercet. Metal. pp. 449-461. /Rumanian/

Mixtures of Al_2O_3 , SiO_2 , MgO , FeO , Fe_2O_3 and TiO_2 , simulating the composition of Anina shale used in Al production, were sintered at $1250^\circ C$ to form water-soluble $Na_2Al_2O_4$. The yield of Al_2O_3 extracted from the sintered oxides decreased linearly from 80 to 65% with increasing Fe_2O_3 content 10% or less.

173. OZDESMIR, S.: The production of alumina from alunite by the Labutin method. Madencilik, Vol. 15. No. 6. 1975. pp. 23-30. /Turkish/

A review is given on chemistry and technology of alumina production from alunites by the Labutin method.

174. Processing of alunite in a fluidized bed. Aluminium Magnesium Elect. Ind. Re. Inst. No. 478, 783 /29 May 1973/. /Soviet patent/

The title process is carried out by calcining, reduction with trapping of the alunite dust in a settling area and clarification. For increasing the extraction of alumina and for decreasing the fuel consumption during reduction of alunite, the preclarification is carried out by addition of 4-10% excess air based on alunite. Then 25-50% of total air is fed to the settling area and 50-75% is fed to the upper part of the fluidized bed.

175. Redox treatment of alunite ore. Southwire Co., National Steel Corp. and Earth Sciences, Inc. No. 3,690,435 /21 Mar. 1974/. Official Gazette, 17 June 1975. /U.S. patent/

A method for recovering aluminium hydroxide and other valuable constituents from ore containing alunite comprises the steps of: roasting the ore to remove water of hydration, roasting the dehydrated ore resulting in a reducing atmosphere to remove sulfate, roasting the reduced ore in an oxidizing atmosphere to convert sulfides to sulfur oxides, leaching the oxidized ore with solvent to remove K and sulfate.

176. SCHOENBORN, N.: Survey on the processes for recovering alumina from clays. *Herrnsdorfer Technische Mitteilungen*, Vol. 15, No. 43, 1975. pp. 1369-1373. /German/

A general review is given with special attention being paid to the alkali sintering disintegration technology of clays which combines the manufacture of cement and alumina with a wide range of quality.

177. Search to bypass bauxite in alumina production. *World Mining*, Vol. 27, No. 3, 1974. p. 45.

The Soviet Union is producing Al_2O_3 from alunite in an industrial-scale operation at Korovobad in the Azerbaijan Republic. The crushed clay mineral is roasted and then processed hydrometallurgically to yield Al_2O_3 and K_2SO_4 for fertilizer as well as V and Ga by-products. Another material being used for Al_2O_3 production in the Soviet Union is nepheline syenite. The U.S. is also investigating non-bauxite Al_2O_3 sources. Aluminum Co. of America is investigating a process using anorthosite, and the alunite route is being investigated by National Steel Corp., Southwire Co. and Earth Sciences Inc.

178. SHAH, R. A. et alii: Extraction of alumina from Ziarat laterite by alkaline leaching. *Pakistan Journal of Scientific and Industrial Research*, Vol. 18, No. 1/2, 1976. pp. 65-68.

Al_2O_3 for Al production was extracted from ores by using NaOH. Effects of NaOH concentration, temperature, time and solid-liquid ratio were investigated. Maximum yield was achieved at 120° C, 45% NaOH, and 100 g solids/l. Extraction was rapid initially and then slowed because of formation of an insoluble complex.

179. ŠAKHTAKHTINSKII, G. B.; SALED-ZADE, K. M.: Reduction of alunite ore by hydrogen sulfide. *Doklady Akademii Nauk Azerbajdžanskoj SSR*, Vol. 31, No. 12, 1975. pp. 22-26. /Russian/

The reduction of alunite ore $[KNaSO_4 \cdot Al_2(SO_4)_3 \cdot 2Al_2O_3]$ by H_2S at 300° to 500° C and SO_2 /in $Al_2(SO_4)_3$ / / H_2S ratios 1/1-1/10 was studied. H_2S was more active for alunite ore reduction than H.

The optimum reaction temperature for the H_2S reduction was 460° to 490° C. Passivation (occurring at approximately 560° C) of the resulting Al_2O_3 is eliminated, which makes possible its total extraction during the subsequent hydrochemical processing of the reduced alunite ore.

80. Shale Oil and Mineral Recovery. Superior Oil Co. No. 74 002,572 /23 Apr. 1974/. /South Africa patent/

Mined oil shale containing nahcolite and dawsonite is crushed to a small size and fed into a preheater where controlled heating decomposes the nahcolite to Na_2CO_3 which is separated out and the oil shale and dawsonite are retorted at a low controlled temperature to recover hydrocarbon products. The pyrolyzed spent shale from the retort is then subjected to a weak caustic leach of controlled composition to recover Al and Na_2CO_3 . Aluminum is precipitated out of the leach liquor in the form of $Al(OH)_3$, which is calcined to Al_2O_3 .

181. SHANNON, W. T. et alii: Pilot-scale production of hydrated alumina, magnesium ammonium phosphate and sodium sulfate from Christmas Island C rock. 1974. Dep. Sci. Ind. Res., Chem. Div., 19 p /Report No. C. D. 2192/

The rock is digested with NaOH to yield a solution of sodium phosphate and aluminate. The Na_3PO_4 is crystallized by cooling and hydrated alumina is prepared from the cooled solution. By treating the Na_3PO_4 with $MgSO_4$ and NH_3 , Mg ammonium phosphate and Na_2SO_4 are prepared.

182. Silicon removal from alkaline aluminate solutions. A. I. Alekseev, No. 506,577 /18 Nov. 1971/. /Soviet patent/

In manufacturing Al_2O_3 from nephelines, alkaline aluminate solutions must be freed from soluble Si by addition of sodium calcium silicate. Removal of soluble Si is rendered more complete by using anhydrous sodium-calcium silicate of composition $Na_2O.CaO.SiO_2$. When aluminate solutions containing initially 2.75 g/l SiO_2 were treated with 100-200 g/l $Na_2O.2CaO.2SiO_2.H_2O$ at 175° C for 1 hr, the SiO content fell only to 1.0 g/l. When the compound $Na_2O.CaO.SiO_2$ was similarly employed, the SiO_2 content fell to 0.13 g/l, an improvement of about five times the original.

183. Simultaneous complex processing of alunite with nepheline. Aluminium, Magnesium, Sulfate. Ind. Res. Inst. No. 434,345 /1. Jan. 1974/. /Soviet patent/

The process is carried out in two parallel branches by obtaining an aluminate solution in the nepheline branch, desilicizing it, centrifuging it and subsequently calcining the $Al(OH)_3$. Also, the aluminate solution of the alunite branch is desilicized. For simplifying the process and decreasing the specific material flow in technological limits, the 30-40% aluminate solution of the alunite branch is evaporated until the concentration of caustic Na_2O is 160-170 g/l and simultaneously centrifuged with the aluminate solution of the nepheline branch.

184. SMIRNOV, M. N. et alii: Methods of complex processing of some varieties of aluminosilicate and other rocks as promising raw material for the production of alumina, alkali products, and cement. In: Problemy Nefelinskogo Syrja, 1975. Akad. Nauk SSSR Nauchn. Sov. Rudobraz. pp. 50-52. /Russian/

Three methods are given for processing of nepheline syenites.

185. SMITH, J. W.; YOUNG, N. B.: Dawsonite. Its geochemistry, thermal behavior and extraction from Green River Oil shale. Q. Colo. Sch. Mines, Vol. 19. No. 3. 1975. pp. 69-93.

Dawsonite $[NaAl(OH)_2CO_2]$ and nordstrandite $[Al(OH)_3]$ occur in the Green River Formation oil shale of the Piceance Creek basin in Colorado. It is a potential source of Al_2O_3 . The most suitable temperature for heating oil shale for both oil and Al_2O_3 recovery is $450^\circ F$. About 94% of the acid-extractable Al_2O_3 was recovered by extracting the heated shale with 0.5M Na_2CO_3 .

186. ŠMORGUNENKO, N. S. et alii: Complex treatment of alunites. Rud. Metal. Zb., No. 2-3. 1974. pp. 189-194. /Slovenian/

A method is proposed for the processing of Zagliksk deposit alunite ore by reduction and alkaline leaching to yield alumina containing over 99.4% Al_2O_3 , K_2SO_4 containing over 91% K_2O , H_2SO_4 , 99.9% pure V_2O_5 , and metallic Ga. The milled alunite is dried and reduced at $540^\circ C$ in a fluidized bed. The flue gases containing about 30% SO_2 are used for manufacture of H_2SO_4 . The reduced alunite is leached at $85^\circ C$ to yield an alunite solution with a caustic modulus of 1.8-1.9 containing 100-120 g Al_2O_3 /l. The SiO_2 is removed and $Al(OH)_3$ precipitated and calcined. The mother liquor is evaporated and returned as a recycle liquor. The Al_2O_3 yield is about 90%.

187. ŠMORGUNENKO, N. S.: Complex processing of nephelines. Rud. Metal. Zb. No. 2-3. 1974. pp. 179-187. /Slovenian/

Flowsheets are given for the commercial production of Al_2O_3 from nepheline ores and nepheline-syenite rocks. Nepheline ore mixed with limestone is sintered under the formation of alkali aluminates

and dicalcium silicate. The sinter is leached and silica is removed from the aluminate solution first by heating in an autoclave /to $\text{Al}_2\text{O}_3/\text{SiO}_2 = 350-400/$ and then through the addition of lime. The resulting alumina contains less than 0.03% SiO_2 .

188. ŠMORGUNENKO, N. S. et alii: Complex processing of nepheline concentrates and ores for obtaining alumina, soda, potash and cement. Problemy Nefelinskogo Syr'ja, 1975. pp. 48-50. /Russian/

A wet charge prepared from a finely ground nepheline concentration or ore and limestone, and having mole ratios $\text{R}_2\text{O}:\text{Al}_2\text{O}_3 = 1.0$ and $\text{CaO}:\text{SiO}_2 = 2.0$, is sintered in a rotary furnace at 1280°C . After cooling, the sinter is leached in a ball mill to obtain the aluminate solution which is separated from the sludge, desilicated and converted to $\text{Al}(\text{OH})_3$. The wasted sludge is used in a charge for a cement plant. The carbonate solutions are used to manufacture potash and dense soda.

189. ŠMORGUNENKO, N. S.: The technology of the complex treatment of high-silica raw materials by sintering with limestone to produce alumina and cement. Rud. Metal. Zb. No. 2-3. 1974./1975. pp. 173-178. /Slovenian/

A technology of alkaline treatment of aluminosilicates was developed. The principal flowsheet consists of charge blending, sintering, cooling and self-disintegration of sinter, leaching by agitation, carbonization of the aluminate solution, dewatering of aluminum hydroxide and calcination. Insoluble mud from leaching is used as raw material for the cement industry. Initially the influence of impurities on sinter properties was studied.

190. SRIBNER, N. G.: Measuring the strength of nepheline-lime granules during drying. Trudy VAMI, No. 91. 1975. pp. 75-81. /Russian/

The strength of nepheline-lime granules was studied as a function of drying conditions and composition. The strength increased with decreasing moisture content, particle size and porosity. At a moisture level of 12-14% the granules were plastic.

191. SRIBNER, N. G. et alii: Physical and mechanical properties of nepheline-lime charges during sintering. Trudy VAMI, No. 91. 1975. pp. 67-74. /Russian/

The granulometric distribution and properties of sinter within a rotating kiln during sintering were determined for granulated nepheline-lime charges. Up to the initiation of recarbonation, the strength and elastic modulus of these charges remained constant.

192. SUTYRIN, Ju. E.: Acid methods for processing products of beneficiation of high-silicon aluminum-containing raw material. *Mineralnoe Syr'ie*, No. 25. 1975. pp. 27-32. /Russian/
- The acid leaching of boehmite-kaolinite ore at higher temperatures was studied. Leaching with 40% HNO_3 in 100% excess at 140° to 180° C removed 94-95% of the Al_2O_3 . The product contained 1-1.5% Fe with the $\text{Al}_2\text{O}_3/\text{Fe}_2\text{O}_3$ ratio 300-500:1. The amount of SiO_2 extracted was 0.01 to 0.1 g/l. A flow diagram is presented for treating alumino-silicate raw materials with HNO_3 .
193. SUTYRIN, Ju. E. et alii: Decomposition of alumina-containing minerals by nitric acid at high temperatures. *Izvestija Vyssih Učebnyh Zavedenij, Cvetnaja Metallurgija*, No. 4. 1976. pp. 38-41. /Russian/
- The nitric acid decomposition of kaolinite, boehmite and gibbsite minerals during autoclave stripping was studied and an X-ray phase analysis of minerals in the residues of acid decomposition was conducted. The purpose of the study was to determine the cause of incomplete conversion of Al_2O_3 into solution during stripping of uncalcined raw materials.
194. SUTYRIN, Ju. E.; MASALOVICH, N. S.: Experiment-planning study of conditions for nitric acid leaching of a boehmite-kaolinite product. *Mineralnoe Syr'ie*, No. 25. 1975. pp. 33-38. /Russian/
- The boehmite-kaolinite raw material contained Al_2O_3 47.5, SiO_2 22.5 and Fe_2O_3 7.6% with the minerals kaolinite, boehmite, gibbsite, diaspor and hydromica. The raw material was preheated for its conversion into acid-soluble form of metakaolinite and gamma- Al_2O_3 . The product was leached in an autoclave with 40% HNO_3 at 120° to 600° C for 1 hr. From the experiment-planning study the best conditions for leaching were 40% HNO_3 at 180° C for 2.5 hr with 95% consumption of the acid. The yield of Al_2O_3 containing less than 1% Fe_2O_3 was 94-95.
195. SUTYRIN, Ju. E.: Selective transfer of aluminum into solution during acid extraction. *Zurnal Prikladnoj Himii*, Vol. 48. No. 4. 1975. pp. 891-893. /Russian/
- To determine the optimal conditions for selective transfer of Al into solution a kaoline-boehmite clay containing Al_2O_3 50.80, SiO_2 17.60, Fe_2O_3 8.66 and TiO_2 2.70% was roasted for 2 hr at 600° C, crushed, and treated in a Ti autoclave with 85-100% of the stoichiometric amount of 20, 30 and 40% HNO_3 for 2 hr at 180° C. The optimum degree of extraction was achieved by leaching with 90% of the stoichiometric amount of 30% HNO_3 for 2 hr at 180° C.

196. SYCHEV, M. M.: Complex digestion of nephelite mud. *Cvetnye Metally*, No. 8. 1975. p. 4. /Russian/

The book discusses the total utilization of nephelite mud -- one of the products of the complex digestion of nephelite ores and concentrates -- and new fields of application. As a complex raw material, nephelite mud is discussed only on pages 106-119 which present the results of a hydrochemical process for mud digestion.

197. THOMPSON, D. L.: Alumina and by-products from Utah alunite -- the Alumet Project. In: "World Mining and Metals Technology". Vol. 2. New York, 1976. Mining and Metallurgical Society of Japan - AIME, pp. 681-684.

The Alumet Co., a partnership of National Steel Corp., the Southwire Co. and Earth Sciences, Inc., is in the final phase of its feasibility study for an Alunite plant. To be located in Southwestern Utah, it could be the first commercial-scale operation in the Western hemisphere to recover alumina from an ore other than bauxite. Sulfuric acid and sulfate of potash are by-products of the process. Alumina production level will be set at 500,000 tons/year. A commercial decision is expected before the end of 1976.

198. USHAKOV, Ju. A. et alii: Dehydration of highly alkaline charges in alumina production. *Cvetnye Metally*, No. 11. 1976. pp. 33-35. /Russian/

The viscoelastic properties of alumina charges of nepheline base were determined as a function of composition and condition of the drying system. Viscosity and limiting shear stress were determined as functions of liquid phase composition and moisture content. Small additions of Na_2O increased initial viscosity by as much as three times for a constant moisture level /30%/.

199. VIDENOV, D. et alii: Study of the conditions for heat treatment of alunite from the Surnitsa Village Region. *Himiija i Industrija*, Sofia, Vol. 48. No. 5. 1976. pp. 199-201. /Bulgarian/

The optimum temperature for the H_2SO_4 or $\text{H}_2\text{SO}_4\text{-H}_2\text{SO}_3$ pretreatment methods is 600° to 650° C. The alunite contains SiO_2 56.8-57.6, SO_2 12.6-13.9, Al_2O_3 14.8-17.3, CaO 1.58-2.12, Fe_2O_3 2.3-3, K_2O 3.18-3.6, Na_2O 0.45-0.48%. By using H_2SO_4 , the extraction of Al does not vary significantly with changing process time or temperature. The concentration of the H_2SO_4 solution does significantly affect the extraction. The dehydration was most efficient in a vibrating fluidized-bed furnace.

4. THE ALUMINA INDUSTRY OF THE WORLD

200. Alumina and aluminium in Japan. *Revue de l'Aluminium*, No. 443. Sept. 1975. pp. 391-393. /French/
- The Japanese MITI Company has decided to decrease its investments for installations in the alumina and aluminium industry, as well as for aluminium-processing from the 1974/1975 level by 10% in 1975/1976. While the total of investments for alumina and primary aluminium production will practically not change, the total of investments for the aluminium-processing industry will diminish by almost 35%.
201. Alumina in Surinam. *Revue de l'Aluminium*, No. 455. Oct. 1976. pp. 439-440. /French/
- The company Ardal og Sunndal Verk initiated negotiations with the respective authorities in regard to construct an alumina and iron plant with a capacity of 200 000 tons of alumina and 190 000 tons of iron.
202. Aluminium in Brazil and Japan. *Revue de l'Aluminium*, No. 456. Nov. 1976. pp. 505-507. /French/
- The Brazilian government requested the Japanese government to put at their disposal 30% of the 386 million dollars needed for ALUNORTE for establishing an alumina plant of 800 000 tons/y capacity. Mitsubishi Aluminium has recently completed its new plant for welded tubes at Fuji.
203. Aluminium in Greece and Yugoslavia. *Revue de l'Aluminium*, No. 451. May 1976. pp. 215-217. /French/
- The "Bauxite of Parnassus" company has recently signed an agreement with the Greek government on an alumina plant to be built. The site of the plant is foreseen at the Corinthus Bay, its capacity should reach 600 000 tons per year with the production to start in 1980.
204. Aluminium in Ireland. *Revue de l'Aluminium*. No. 449. Mar. 1976. pp. 115-117. /French/

The ALCAN Aluminium Company and its partners ASV and Granges decided to adjourn the start of construction for an alumina plant with a projected 800 000 tons/year capacity at the Aughinish island, due to the mediocre demand for aluminium.

205. Aluminium in Jamaica. Revue de l'Aluminium, No. 451. May 1976. pp. 215-217. /French/

The ALPART company exploiting an alumina plant of 1,180 000 tons per year is owned to 36.5% by Kaiser, 36.5% by Reynolds and 27% by Anaconda; it is actually operating by only 65% of its capacity.

206. Aluminium in Norway and Yugoslavia. Revue de l'Aluminium, No. 455. Oct. 1976. pp. 339-440. /French/

Norsk Hydro in Norway has applied for permission to increase its capacity from 75 000 t/year at the Karmoy plant to 185 000 t/y. The company hopes to start extension work not later than in 1978. Energoinvest in Yugoslavia has the intention to deliver the total production of its new alumina plant at Zvornik of 600 000 t/y to the USSR for a period of 10 years.

207. BAUDART, G. A.: Aluminium in Jamaica. Revue de l'Aluminium, No. 437. Feb. 1975. pp. 67-69. /French/

Five Japanese firms joined in the corporation Revere Jamaica Alumina Limited in order to realize the extension of the alumina plant at Revere. The projected capacity is 520 000 tons yearly. The expansion costs are estimated to 100 million dollars.

208. Development and prospects of the Venezuelan aluminium industry. Revue de l'Aluminium, No. 456. Nov. 1976. pp. 496-497. /French/

The Venezuelan Government has started an extensive project: the construction at Ciudad Quayana of an alumina plant of 1 million ton annual capacity, representing a capital cost of \$ 540 million. It would seem according to certain sources that Venezuela has 4 500 000 tons of proved bauxite reserves and 100 million tons of unexplored reserves. It does not seem as if these reserves were inexhaustible and unless new discoveries are made the Government will most likely be concerned to preserve them to a certain extent.

209. HUGUENEY, M.: Aluminium in the United States. Revue de l'Aluminium, No. 436. Jan. 1975. pp. 13-14. /French/

Kaiser introduced a new production process in its alumina plant of Gramercy for recycling red mud which up to the present time was discharged into the Mississippi; the process consists of

spreading the red mud on a sand bed of about 80 hectares encircled by a 9 m high embankment under which drainage tubes are placed. By these tubes filtered alkaline-water is collected and retransported to the plant for neutralization. The construction of the recycling plant lasted 2 years and the costs reached 16 million dollars.

210. HUGUENY, M.: The Norwegian aluminium industry; new trends. Revue de l'Aluminium, No. 434. Aug/Sept. 1976. pp. 390-393. /French/

The Norwegian aluminium producers secured their alumina supplies until now through barter deals. At present they have long-term import agreements with such foreign suppliers as ALCAN, ALCOA, Alusuisse, Martin Marietta.

211. McLEOD, P.: An outline of the Australian aluminium industry. Metal, Australia, Vol. 8. No. 5. Jan. 1976. pp. 103-106.

The history of the Australian Al industry is reviewed briefly and the nature of the Australian bauxite deposits is outlined. The production of Al_2O_3 is discussed with special reference to the individual steps necessary to obtain Al_2O_3 from bauxite. The reactions involved in the smelting of the Al_2O_3 are discussed in relation to the operation of the electrolytic reduction furnaces. Finally the raw materials required to sustain an Al extraction industry are reviewed briefly.

212. MISSONNIER, H.: Aluminium trends in 1974. Revue de l'Aluminium, No. 439. Apr. 1975. pp. 187-188. /French/

At the end of 1974 the productive capacities of hydrated aluminium /as by weight of alumina content/ represented about 28.1 million tons yearly, 1.4 millions /+ 5.2%/ of tons more than at the beginning of the said year. The production rose first of all in Australia, Yugoslavia and India.

213. NIONCEL, J.: ALCOA, first in the world as producer of aluminium. Revue de l'Aluminium, No. 459. Feb. 1977. pp. 57-61. /French/

Surinam and Australia are the two main bauxite sources of ALCOA. In Guinea the very rich and vast deposits at Boké are producing bauxite since 1973; ALCOA owns 13.8% of the Guinean Bauxite Company. In Costa Rica, ALCOA has started preliminary work with the view of exploiting deposits for supplying a future alumina plant. Two new alumina plants started their operation in 1972: one in Jamaica with an initial capacity of 480 000 tons yearly to be expanded to 560 000 t/y by 1977; an other in Australia at Pinjarre with an initial capacity of 270 000 t/y to be increased

gradually to 2 millions of tons/y by 1976. ALCOA has a total capacity of 6.8 million tons yearly and is producing more alumina than it utilizes in its electrolysis plants; however, as Kaiser, the company is developing its production of special aluminas for refractories and other uses.

114. NIONCEL, J.: Aluminium in Brazil. Revue de l'Aluminium. No. 443. Sept. 1975. pp. 391-393. /French/

The cost estimation for the Belen project has been assessed anew, the new figures being as follows:

Alumina plant /capacity 1,300 000 t/y/	£ 633 millions
Aluminium plant /640 000 t/y/	£ 1465 millions
Hydroelectrical installations	£ 781 millions
Long-term working capital	£ 134 millions
Infrastructure	<u>£ 362 millions</u>
Total	£ 3385 millions

5. SPECIFICS OF EQUIPMENT IN THE ALUMINA INDUSTRY

215. Aluminate solution carbonization plant. Aluminium, Magnesium Elect. Ind. Re. Inst. No. 498,025 /3 June 1974/. /Soviet patent/

To prevent the possibility of stopping for cleaning any group of carbonization units without stoppage of the entire plant processing the aluminate solutions by carbonization with flue gases from sintering or calcinating furnaces in hydrometallurgical industry, the last carbonization unit in every top group is equipped with two transporting airlifts connecting it with first carbonization units of the tailing group, as well as with a stirring airlift. The transporting airlifts are sectional and contain lifting mechanism.

216. BARAKKA, I.; NEMETH, B.: Instrumentation and automation of an alumina plant washing line. Bányászati és Kohászati Lapok, Kohászat, Vol. 107. No. 7. 1974. pp. 12. /Hungarian/

The instrumentation and automation of the alumina washing line at the Almasfuzitő Works are described. Mud removal is controlled by a novel method of measuring the transition zone.

217. BARAKKA, I. et alii: Off-line computerized process control in alumina production. Bányászati és Kohászati Lapok, Kohászat, Vol. 109. No. 11. 1976. pp. 518-521. /Hungarian/

The model developed for the off-line process control of the Almasfuzitő Alumina Works is presented. It contains a program applicable to the DDRA 1024 computer or the Hungarian computer TPA/1. Experimental operation of the program system has yielded results which indicate that its introduction will lead to significant economic benefits.

218. BERKH, V. I.; KRASNOPOLSKY, E. D.: A structure of algorithm of a cascade control system for the alkaline mode of the process of carbonation of an aluminate solution. Trudy VAMI, No. 88. 1974. pp. 132-137. /Russian/

A cascade control system was devised for carbonation of aluminate solutions in alumina production. The system included automated pH control and feedback. A schematic diagram of the system is shown. Equations were derived for the algorithm and for the

material balance in the carbonation battery. This control system was introduced into a plant in 1970 and has been used since then.

219. CHERNYKH, S. I.: Modernization of circular mills for dry milling of alunite in the Kirovabasky aluminum plant. *Cvetnye Metally*, No. 9. 1975. pp. 79-80. /Russian/

A study was conducted on the distribution of alunite along the drum of a milling machine to improve the design. Distribution profiles of alunite ore of varying coarseness, ranging from 90 to 1000 microns, are presented. As a result of the study, the drum was redesigned to promote proper distribution of matter during milling. The new design resulted in improved efficiency of 13.8 tons/hr.

220. COUSINEAU, B. L.; LUMSDEN, J. R.: Development of a self-slucing pressure leaf filter. In: "Light Metals 1976". Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 175-183.

Tests of various sluicing and reslurrying spray arrangements led to the design of a self-slucing press which used the shell of an existing Kelly press with its main axis vertical. Modifications to leaf spacing, spray rotational speed, spray slot width, feed pressure and pre-coat control, allowed effective performance for all of the 800 hours canvas life. Advantages are: reduced operating and maintenance manpower, clean environment, and reduced maintenance cost. The use of first wash overflow for sluicing has reduced caustic soda and canvas consumption.

221. DOMANSKY, I. V. et alii: Circulation speed of the suspension in a precipitator with air mixing. *Trudy VAMI*, No. 91. 1975. pp. 99-104. /Russian/

An experimental method was used to determine the suspension rate as a function of air speed, suspension concentration and air tube diameter. Work was done on a unit of standard design used in alumina plants for mixing various suspensions. The rate of suspension increased parabolically as a function of air speed, but decreased as a function of decreasing tube diameter and increasing suspension concentration.

222. EKIMOV, V. A.; KHODOROV, E. I.: Study of the degree of temperature uniformity of material on the exposed surface layer in a rotating kiln. *Trudy VAMI*, No. 88. 1974. pp. 58-71. /Russian/

Model experiments were conducted in a laboratory kiln to study heat transfer in the exposed surface layer of particulate material heated in a rotating kiln. The dropping particles in the exposed layer come in contact with a hot gas stream and then are tumbled

into bottom layers of material, thereby transferring heat within the mass. A theoretical equation gives the average change in temperature of the exposed surface layer as a function of time and physical constants of the material. On the basis of experiments conducted in a model kiln, using nepheline particles of different coarseness, the temperature increase of the surface layer gets bigger as the heating temperature increases and as the rate of rotation decreases. Values of constants in the theoretical equation for temperature change in the surface layers were determined.

223. **ERMIN, I. I. et alii:** Intensification of autoclave processes in the production of alumina. *Izvestija Vyssih Ucebnyh Zavedenij. Cvetnaja Metallurgija*, No. 4. 1975. pp. 17-23. /Russian/

Advances in autoclave technology and equipment are discussed in relation to the leaching of bauxites for alumina production. Cross-sectional views of two new types of autoclaves, equipped with heaters and mixers, are shown. Also shown are schematic diagrams of single- and two-stage autoclave leaching processes. Higher temperatures /in the range 205-280° C/ greatly accelerate the conventional leaching processes. Soviet work is reviewed in which temperatures up to 360° C are used in autoclaves with tubular reactors. The operation of a high-temperature tubular reactor is described, and heat transfer coefficients are presented for this reactor.

224. **FAIN, I. M. et alii:** Automated control system for thickening and control filtration during the digestion of hydrate slurries. *Trudy Vsesojuznogo Naucno-Issledovatel'nogo Proektnogo Instituta Aljumino Magnievoj Elektr. Promyslennosti*, No. 88. 1974. p. 9. /Russian/

The automated system developed with consideration of the basic problem of control realizes two interrelated algorithms: control of the thickening process and matching the productivity of the different pieces of equipment.

225. **FAIN, I. M. et alii:** Automation of a control system for processes of thickening and filtration control in the processing of hydrated pulps. *Trudy VAMI*, No. 88. pp. 125-131. /Russian/

Techniques of automating pulp processing in alumina production were developed. Automation algorithms were written for controlling the thickening and filtration of hydrated pulps. A schematic drawing of the carbonation battery used in the pulp processing is shown. Pilot trials were conducted in the automated carbonation battery, and production data are presented, showing the change in pulp density as a function of time. It is concluded that a

saving of 32 000 rubles can result from applying automation to the carbonation battery in alumina plants.

226. FINKELSHTEYN, L. I. et alii: Selection and adoption of linings for high-capacity rotary kilns in alumina production. *Cvetnye Metally*, No. 5. 1976. pp. 40-42. /Russian/

A series of refractories, multi-grog, filler of crushed porcelain, periclase, chrome-magnesite and magnesite-chromite were tested in the sintering zone of a rotary kiln. None gave satisfactory service life for linings in this area. Satisfactory properties were obtained from a combined lining consisting of a combination of acidic and neutral refractories alternating in rows or in a row in a ratio from 0.5 to 1 to 3 to 1. The stability of the lining in the various kilns reached 180 days resulting in reduced refractory costs and relining operations.

227. Industrial gas burner has outlet nozzle and moveable swirler. No. 428,159 /23 July 1970/. /Soviet patent/

The burner can be used in revolving furnaces employed for cement clinker, kermesite and refractory material roasting and in Al industry for sintering and calcination. To increase the flame parameters regulation range, the swirler is combined with a throttle situated along the periphery and forming an annular gap with the nozzle walls. Gas is supplied to burner. When throttle is in the extreme right position an annular gap, which stabilizes the flame, is formed between nozzle and throttle. In this position practically all the gas stream is concentrated inside the throttle and as it passes through swirler is given maximum swirl. When the throttle is in the extreme left position, the main gas stream passes the swirler and emerges through the nozzle at a velocity specified by the nozzle cross-section.

228. KARFIDOB, A. F.; ILENICH, V. N.: Designing airlifts for alumina production. *Cvetnye Metally*, No. 7. July 1976. pp. 43-47. /Russian/

Methods were studied for calculating the optimum dimensions and operating modes for airlift conveyors that would assure a minimal compressed air consumption per unit volume of slurry being transported. By selecting different combinations yielding a dimensionless expression, good agreement was found between a mathematical model developed and available experimental data. From the equations obtained it was possible to determine the optimal conveyor diameter at the given slurry flow rate, the specific air consumption at the optimal conveyor diameter and the optimal diameter at the assigned pump productivity.

229. KAZAKOV, V. G. et alii: Criteria of thermodynamic efficiency of local thermal networks in the production of alumina. Trudy VAMI, No. 88. 1974. pp. 13-20. /Russian/

A theoretical analysis was made of the thermodynamics of localized heat transfer in heat exchangers used in autoclave leaching of bauxites. An equation was derived for calculating the exoergic efficiency of a local heat transfer system and used in deriving other thermodynamic functions. Schematic drawings of a heat exchanger, mixer and evaporator used in alumina production are shown. All these systems were related to the analysis of exoergic efficiency. 16 ref.

230. KHODOROV, E. I.; KOROLKOV, A. V.: Analysis of thermal processes occurring in multichamber furnaces during the sintering of alumina mixtures. Trudy VAMI, No. 81. 1971. pp. 112-119. /Russian/

An analysis was made of heat transfer occurring in a new sintering process used in the production of alumina. A four-stage furnace that is the basis of the new process consists of the following stages: granulation, preheating, sintering and cooling. Heat transfer calculations were made for each stage, and the results are presented for fuel consumption, temperature of the sintered particles and gas temperatures in the furnace as a function of excess air in the sintering chamber. The specific heat expenditure in the production of bauxite sinter in the four-stage furnace is 1180 kcal/kg. This is 12-13% less than required in a rotating kiln.

231. KHODOROV, E. I. et alii: Study of the residence time of material on the exposed surface layer in a rotating kiln. Trudy VAMI, No. 88. 1974. pp. 48-57. /Russian/

A theoretical analysis was made of the mass transfer in the exposed surface layer of sinter material heated in a rotating kiln. Photographs show cross-sectional views of a rotating cylinder and the flow of loose material contained within it. Relationships between the geometry of particle flow and the diameter of the rotating kiln and angular velocity are presented in graphs. The drop acceleration of particles in the exposed surface layer increased as the amount of filling of material increased and as the parameter $n/Dg^{1/2}$ increased, where n is the rotational velocity, rpm, D is the kiln diameter, m, and g is the gravitational constant, m/sec². The time of contact between exposed material surface and gas flow within the kiln decreased with increasing drop acceleration.

232. KUZO, I. V. et alii: Permissible deviations in the axis of rotation of a rotary kiln. Cvetnye Metally, No. 8. Aug. 1976. pp. 48-49. /Russian/

The alternating sign loads and stresses in the cross-section of a rotary kiln cause fatigue in the steel resulting in decreased strength. The maximum permissible deviation of the rotational axis from the linear was determined for several steels. It was concluded that the permissible deviation should be assigned separately for each unit based on the kiln design, the shell material and the operating conditions.

233. **LEYTEYZEN, M. G. et alii:** Outline of the equipment and technology for digesting North Omega bauxites. *Cvetnye Metally*, No. 4. Apr. 1975. pp. 8. /Russian/

Various methods of processing northern Onezhsky bauxites were evaluated. The mineral content of these ores is as follows /wt %/: boehmite 11.0-56.0, gibbsite 10.0-30.0, kaolinite 20.0-47.0, hematite 3.0-18.0, anatase + rutile 2.5-3.0, calcite 0.0-0.5, gypsum 0.0-10.0, analcite 0.0-0.3, pyrite 0.0-2.0, Cr minerals 0.0-2.0, chlorite 0.0-2.0, mica 0.0-5.0. Three different processes were analyzed on the basis of capital costs and efficiency. These were the Bayer, Bayer-sintering and sintering processes. The need for calcined soda was eliminated in processing these ores.

234. **MATULA, M. et alii:** Design of red mud settling equipment. *Bányászati és Kohászati Lapok. Kohászat*, Vol. 109. No. 5. 1976. pp. 228-234. /Hungarian/

A mathematical model and method of calculation, based on the data supplied by a modern radiation absorption test method, can be used for designing settling and washing equipment for alumina factories and also for developing algorithms for process control by computer. The development of the measuring technique and of the mathematical model was primarily discussed and the application for design purposes was mentioned.

235. **MAYER-WENGELIN, F.:** Problems of conveyance in the extraction of aluminum oxide. *Erzmetall*, Vol. 29. No. 6. 1976. pp. 262-270. /German/

The report summarizes experience that has been gathered in the transport of alkaline media in the alumina works of the Vereinigte Aluminium-Werke AG. Typical problems of conveyance are described by means of a review of the Bayer process. Determination of the tube resistance coefficients during the operation of the plant is reported in connection with the design of conduit and pumps /effect of erosion by the aluminum hydroxide conveyed/. Experiments with valves, rotary pumps and high-pressure piston diaphragm pumps are explained and ways of improving pump life and reducing repair costs are shown.

236. MERCIER, H.: Alumina production. Details of laboratory experiments in a pilot plant and its industrial realization. *Industrie Minérale, Métallurgie*, No. 2/74. Oct. 1974. pp. 125-128. /French/
- The construction of a new alumina plant is based mostly on experiences gained in numerous existing plants and does not necessarily involve pilot plant scale studies. The process described can be defined as a big-scale laboratory experiment, the characteristics of which are analogue to the utilized treatment.
237. NÉMETH, B. et alii: Analog and digital computers in alumina production. *Bányászati és Kohászati Lapok, Kohászat*, Vol. 109. No. 10. 1976. pp. 467-470. /Hungarian/
- The conditions required for computer control in alumina works are studied and the control systems using analog and digital computers realized at the Almasfuzitő Works are described. 18 ref.
238. NÉMETH, B.: The changes which have occurred since 1970 in the instrumentation and automation of the Almasfuzitő alumina plant. *Bányászati és Kohászati Lapok, Kohászat*, Vol. 108. No. 10. 1975. pp. 477-480. /Hungarian/
- The changes in the instrumentation and automation of the Almasfuzitő alumina plant are described as well as the principles of the new solutions, operational experience and the results achieved to date in the preparations for computer control of the processing. 18 ref.
239. PCHELOV, V. M. et alii: Calcination of aluminum hydroxide in cyclone-type units. *Metallurgia i Kokshimija*, Vol. 45. 1975. pp. 68-71. /Russian/
- A method of preparing Al_2O_3 by calcining $Al(OH)_3$ in a fluidized bed was developed. Fine particles were calcined in the cyclone part of a reactor and larger ones in the ascending current of a heat carrier. Preliminary mixing of the gas and air in burners and their intense mixing in the cyclone part of the reactor ensured high temperature levels and course of the recrystallization process as well as increased active surface of the product characterized by the content of alpha- Al_2O_3 . When the velocity of the reaction phase is 5-10 m/sec in the cyclone, the required process occurs within several seconds. At 1256° to 1400° C, a fine-grained alpha- Al_2O_3 is obtained with a mean grain size of 10-40 microns.
240. RYBKIN, V. D. et alii: Mathematical description of the thermal regime of calcination in rotary kilns. *Teoričeskie Osnovy Himičeskoj Tehnologij*, Vol. 9. No. 6. 1975. pp. 930-933. /Russian/

A mathematical description was given of the thermal process of calcination of the Al_2O_3 hydrate resulting in the evaporation of moisture /at $115-117^\circ \text{C}$ / and recrystallization of $\gamma\text{-Al}_2\text{O}_3$ into $\alpha\text{-Al}_2\text{O}_3$. This is consistent with the motion of the material from the cold end to the hot end of the rotary kiln fired by gases that moved across the material. Differential equations represented the thermal regime of the furnace at the two investigated zones. Calculations based on these equations were in good agreement with experimental data.

241. **SEKULOVIC, V.; VRACAR, R.:** Investigations on apparatusive solutions of bauxite leaching in a pipe reactor at high temperatures. *Rud. Metal. Zb.*, No. 2-3. 1974-1975. pp. 261-269. /Slovenian/

The application of a pipe reactor instead of a series of autoclaves makes possible a more intensive mixing of pulp, a more bauxite particles in the reactor, higher temperatures, and thus an improved leaching rate and better profitability of the Bayer alumina process. Investigations into apparatusive solutions of bauxite leaching in two pipe reactor types were made: the first pipe reactor had combined heating /secondary pulp-leached pulp-electric energy/ and the second one was heated by diphile. The pulp is charged by two parallel two-stage membrane-piston pumps. The critical flow-rate causing no precipitation of particles was calculated according to an equation. The heat balances of the process are given in a flowsheet and the dimensions of the reactor were determined according to an equation where the over-all heat transfer coefficient is determined. In the pipe reactor using diphile the pulp is heated by diphile vapor at 332°C and 4 atm pressure while the leached pulp heats up the liquid diphile from 70° to 250°C in the heat exchanger as the pulp cools down to 150°C . Heat balances in the process are given. After the heat transfer coefficients have been calculated the reactor dimensions can be determined. In the pipe reactor with combined heating 50% of the total necessary energy was supplied by electric heating and in the pipe reactor with diphile 45% of the total necessary energy was supplied by the combustion of heavy oil.

242. **WETZEL, B.:** Disk filter performance improved by equipment redesign. *Filtration and Separation*, Vol. 11, No. 4, Mar. 1976. pp. 270-271, 275.

By using 30 segments instead of 12, capacity was increased by 10%. The improvement of cake discharge 95% or less against the previous 75% increased capacity by 25%. Due to the higher speed of operation permitted by the new design due to the very favorable

cake discharge characteristics, capacity was increased a further 35%. By reducing down-time, capacity was further increased by 20%. All this adds up to a doubling of the capacity of the filters compared with their forerunners. The filtration in the Bayer process and the filtration of gypsum from H_3PO_4 are given as example.

6. ENVIRONMENTAL ASPECTS OF THE ALUMINA INDUSTRY

243. Calcination of aluminum hydroxide. Aluminium, Magnesium, Bauxite Ind. Re. Inst. No. 497,236 /24 Dec. 1973/. /Soviet patent/

Process is carried out in a countercurrent stream with flue gases, the dust being trapped and returned to the cycle. For increasing the productivity of the process, 10-40% of the trapped dust is added to the cocurrent stream with flue gases and the remaining dust is added with the $Al(OH)_3$.

244. DAVIES, V. E.: Experience gained by unloading red mud into the sea. Revue de l'Aluminium, No. 443. Sept. 1975. pp. VI. /French/

A description of the site of the alumina plants of the British Aluminium Company at Newport, Monmouthshire, is given emphasizing their influence of the methods used by them of getting rid of red mud.

245. ELPERIN, I. T. et alii: Aspects of the trapping of alunite dust in countercurrent dust catchers. In: "Protsessy Perenosa Tepla Massy Sushke Razlichnykh Mater." Minsk, 1974. Akad. Nauk B. SSR, Inst. Teplo-Masloobmena, pp. 210-214. /Russian/

Finely dispersed dust emitted from fluidized bed for alunite /I/ calcination was more readily trapped than dust emitted from furnace for I reduction. The wettability of both kinds of dust and the variation of I dust composition with the degree of its trapping were examined by analyzing the precipitated dust for Al_2O_3 , Na_2O , K_2O and SiO_2 . The percentage of SiO_2 increased with decreasing the degree of trapping, while that of Al_2O_3 decreased. The Al_2O_3 percentage and $Al_2O_3:SiO_2$ ratio in dust from reduction furnace decreased more sharply with decreasing trapping efficiency than that from fluidized bed furnace. Multicomponent technological dust is best segregated by multistage countercurrent dust collectors.

246. GAVRILOVA, V. A.: Evaluation of the hygienic aspects of new technologies for continuous leaching of bauxite sinter. Trudy VAMI, No. 31. 1971. pp. 109-111. /Russian/

An hygienic evaluation was made of several aspects of a new continuous leaching process for extracting sodium aluminate from sinter in the production of alumina. Several recommendations were

made to improve the process from a hygiene standpoint. These included the reconstruction of the ventilation system, covering tanks, insulating the tubing and improving the air circulation in the leaching building.

247. Hardening waste-water sludges using a composite cement and calcium lignosulfonate mix. Kurita Industrial Co. Ltd. No. 75 033,175 /27 July 1973/. /Japanese patent/

Sludge from waste water-treating plants, metal-refining processes, etc. is mixed with a hydraulic hardening agent under heating and dehydrated after stiffening. For example, 100 parts red mud containing 41% water, from an Al refining plant was mixed with 7 parts of a 3:2 high-early strength cement-Portland cement mixture and 1% /based on the cement/, calcium lignosulfonate in a mixer. The mixture was agitated for 5 min while heating by injecting steam, poured into a mold when its hardness reached 3, and compressed at 350 kg/sq cm. The resulting hardened product had hardness 15.

248. HODOROV, V. I. et alii: A study of dust entrainment on a model rotating kiln. Trudy VAI, No. 38. 1974. pp. 72-82. /Russian/

An experimental study was made of the generation and entrainment of dust during the operation of a model rotating kiln. The materials studied were bauxite sinter, sand, magnesia ore and iron ore. Particle size and geometry parameters are presented as a function of kiln diameter and rotational velocity. An empirical formula was developed relating the dust concentration in the exit gases to the operational variables. The effect of gas flow velocity on dust concentration depended on the particle size distribution of the material processed.

249. HVAŠTUHIN, Ju. I. et alii: Efficiency of scrubbers after the granulator and fluidized-bed kiln in the production of coagulants. Himija i Tehnologija, Kiev, No. 5. 1974. pp. 40-42. /Russian/

A system composed of Doyle scrubber, gas washer and polypropylene filter was suggested for wet purification of gases after the granulator and fluidized-bed kiln in the processing of kaolin and alunite. The content of SO_2 and dust was determined in waste gases using the scrubbing apparatus separately or in combination. The gas temperature and pressure were measured at the input and outlet of each apparatus. The efficiency of SO_2 removal was about 50% with either the Doyle scrubber or gas washer or their combination. This efficiency increased to 80% when these apparatus were combined with the polypropylene filter. The efficiency of dust removal increased from the Doyle scrubber /70%/, with the gas washer /30%/

and their combination /97% to the simultaneous use of all three /99%/. Large particles of dust 1-0.25 mm/ were found in the trap of the Doyle scrubber in amounts of 40%, whereas in the flue the amount was only %.

250. LAINER, A. T. et alii: A study of the process of alunite dust recovery in counterflow air streams. Ovetnye Metally, No. 9. 1975. pp. 42-45. /Russian/

The mean of recovering alunite dust in counterflow air streams was developed. The recovery system involves the consolidation of dust from countercurrent air streams by a water spray. A schematic diagram of an experimental recovery system is shown. Water spray is injected into both countercurrent streams which collide in a precipitating chamber. The dust is recovered in the bottom of the chamber. Experimental data show the influence on dust recovery of the amount of water injected into each air stream, dust concentration in the air streams and velocity and temperature of the air streams.

251. MOODIE, S. P.; HANSEN, R.: Disposal of solid wastes from an alumina refinery. In: "Treatment, Recycle and Disposal of Wastes", Australia, 1975. Institution of Chemical Engineers, pp. T22-T25.

An alumina refinery must dispose of about 3/4 of a ton of solid wastes for every ton of alumina produced. About 90% of this is tailings called "red mud", with lesser percentage of red sand and ash. The red mud had an average composition of Fe_2O_3 31.5%, TiO_2 7.0%, SiO_2 14.5%, Al_2O_3 25.5% and Na_2O 7.5%. Efforts have been made to use the red mud by reclaiming its mineral content, using it as an additive in clay products for producing bricks and light-weight building materials and miscellaneous applications. In the reclamation of red mud, efforts were made to separate it into Al_2O_3 and Fe_2O_3 and reclaim these. Some substantial work was reported on process smelting by the Russians. The Japanese have been able to separate the red mud into the basic oxides with limited success. Using red mud as an additive for clay products, some high-grade, light-weight ceramic parts have been produced. Typical miscellaneous uses for red mud were listed as flocculating agents for waste water treatment and for soil stabilization and conditioning.

252. Separation of red mud from waste water. Kurita Water Industries, Ltd. No. 75 096,460 /27 Dec. 1973/. /Japanese patent/

Red mud is separated from the waste water by flocculation with poly/Na acrylate/ and cationic polymer flocculents. The over-all

effects of the polymer and the cationic polymer flocculent mixture on the floc settling rate and suspended solids removal are more effective when compared to those using the polymer or the cationic flocculent alone. Thus, 160 g bauxite /containing 120 g Al(OH)₃/ was treated with 1 l 19.4% NaOH, heated for 1 hr at 130° to 150° C, and then cooled to 95° C. The red mud sludge thus produced was first mixed with 25 ppm poly/Na acrylate/ /molecular weight about 5.4×10^6 , viscosity at 30° C in 2N NaOH = 4.1/ /reagent A/ and then with 5 ppm poly[[beta-/methacryloyloxy/ethyl]trimethyl-ammonium chloride] viscosity at 30° C in N NaNO₃ = 4.1/ /reagent B/ at 95° C. The mixture at 95° C had a floc settling rate of 8.8 m/hr and contained 150 mg suspended solids/l; however, in the control liquor, where no reagents were added, the floc settling rate was 800 mg/l. When 5 ppm reagent A or 25 ppm reagent B was added, the floc settling rate was 8.9 or 0.81 m/hr, respectively, and the suspended solids concentration was 260 or 110 mg/l, respectively.

253. VOGT, M. F.; STEIN, D. L.: Dewatering large volume aqueous slurries; sand bed filtration of bauxite residue. In: "Light Metals 1976". Vol. 2. New York, 1976. Metallurgical Society AIME, pp. 17-132.

Dewatering techniques were investigated for the problem of land disposal of bauxite residue at Kaiser's two Louisiana alumina plants. Development of suitable processes was particularly important because of South Louisiana weather conditions, where an excess of rainfall over evaporation is typical. A sand bed filtration system was selected and is now in operation at the Kaiser Gramercy Works. This process is shown to reduce red mud slurry volumes from one third to one fourth of the initial volume. Given the slurry characteristics and system design, the impounded mass will, upon reaching its maximum consolidation, show little tendency to repulp. Indications so far are that the impoundment area, upon stabilization at the surface, may be reused for farming /after replacing topsoil/ or mining of the mud for other uses. The application of this process to other slurries composed of fine solids which settle slowly to a low solids content are discussed.

7. ECONOMIC AND COMMERCIAL ASPECTS

254. **Almasfuzit6 expansion.** Mining Journal, Vol. 287. No. 7374. 17 Dec. 1976. p. 481.

Expansions are underway at the Almasfuzit6 alumina plant in Western Hungary to expand output from around 300,000 tons/year to 325,000 tons/year.

255. **Alumina for Venezuela.** Mining Journal, Vol. 286. No. 7342. 7 May 1976. p. 368.

Venezuela has entered into agreements to purchase \$ 150 million worth of alumina over the next five-year period. According to reports from Puerto Ordaz, Alcasa will buy one million tons alumina from Jamaica and Surinam to cover requirements for the company's smelter being established at Matanzas, near Puerto Ordaz.

256. **Alwest redefined.** Mining Journal, Vol. 287. No. 7374. 17 Dec. 1976. p. 475.

The reformulated plan involves the estimated investment of \$ 650 million in an 800,000-1,000,000 tons/year alumina refinery.

257. **India. Emphasis on alumina.** Mining Journal, Vol. 287. No. 7351. 9 July 1976. p. 27.

The government is presently considering plans to establish an alumina refinery near Vishakapatnam in Andhra Pradesh which will use the port's facilities. An export-orientated refinery was originally planned in Madhya Pradesh.

258. **New era for Spain. Aluminium expansion.** Mining Journal, Vol. 287. No. 7351. 9 July 1976. pp. 21-22.

Production of aluminium continues to expand, rising by 9.9% last year to 210,000 tons. There were only two producers - ENDASA - /123,000 tons/ and ALUGASA. In 1975 imports of this material rose by 12% to 400,000 tons costing \$ 67 million.

259. **New phase for Western Australia.** Mining Journal, Vol. 287. No. 7364. 8 Oct. 1976. pp. 273-274.

In 1976 dollar values, \$ 4,000 million has been invested in the past 16 years in Western Australia's sharp increases in alumina production capacity. Alcoa intends joining Alwest to start during this financial year the building of the world's biggest alumina refinery.

260. Philippine alumina. Mining Journal, Vol. 284. No. 7296. 20 Jun. 1975. p. 479.

A multinational consortium plans to start alumina output on Mindanao Island, Philippines, early in the next decade. Present plans envisage the establishment of a joint venture, currently known as West Pacific Alumina Corp., by the end of this year. Capitalisation and equity is currently being discussed by Comalco, Consorcio Riotinto of Australia, Holland Aluminium NV, Kobe Steel, Mitsubishi Chemical Industries, Nippon Light Metal, Kaiser Aluminium and Reynolds Metals Corp.

8. PROPERTIES OF ALUMINA

261. ERMAK, V. L. et alii: Mechanism for specific surface stabilization of aluminium oxide at 1000-1200° C by the addition of alkali metal oxides. Trudy, Gosudarstvennogo Instituta Prikladnoj Himii, No. 68. 1973. p. 7. /Russian/

The stabilization of the specific surface area of Al_2O_3 at 1100° to 1200° C by addition of alkali metal oxides M_2O is due to the inhibition of a $\alpha\text{-Al}_2\text{O}_3$ phase formation by the M_2O . The additives penetrate into the Al_2O_3 crystalline-lattice rearrangement. The specific surface area was measured by Hg porometry and the crystalline structure was determined by X-ray diffraction. The M_2O were Li_2O , Na_2O , K_2O , Rb_2O and Cs_2O .

262. LEIPOLD, W. et alii: Possibilities of particle size characterization of aluminas. Berichte der Deutschen Keramischen Gesellschaft, Vol. 52. No. 8. 1975. pp. 263-268. /German/

The title subject was studied by Andreasen's /1971/ theory of sedimentation and micrographic particle-size distribution and determination of specific surface areas by gas permeation and gas adsorption. These methods proved useful for the evaluation but the results were not quite comparable as they did not give the true grain-size distribution or the mean particle size. This was partly due to the shape of the particles and partly to the presence of aggregates in the aluminas.

263. MITRA, S. K. et alii: Study on the slag corrosion of high-alumina bricks. In: [Proc. Seminar] High-Alumina Refractories, Calcutta, May 1973. [1976] pp. 86-94.

The corrosion of commercial refractories containing Al_2O_3 45-60% by slag in reheating or o. h. furnaces was studied. The effects of Al_2O_3 content and physical properties of the refractory, furnace atmosphere, and nature of the slag on the rate of corrosion are discussed.

264. PAUKER, V. I. et alii: Increasing the effectiveness of sintering of high-iron red mud. Mineralnoe Syz'nie, No. 25. 1975. pp. 14-26. /Russian/

The high-Fe red mud contained Al_2O_3 22.46, Fe_2O_3 22.5, SiO_2 19.35, CaO 1.54, TiO_2 5.5, SO_2 1.61 and Na_2O 13.0%. The maximum extraction of Al_2O_3 and Na_2O of 87.7 and 94.9%, respectively, was found when

the system was held at 1300° C for 5 min. Calcite and soda were added to the system for the case of higher Fe₂O₃ contents. The presence of petroleum coke in the system /1.6%/ for reducing Fe₂O₃ into FeO or Fe in an Ar atmosphere improved the Al₂O₃ and Na₂O extraction to 86.3-93.2 and 96.2%, respectively, when the system was held at 1150° C for 30 min. Also, extraction of Na₂O and Al₂O₃ increased in systems having a reducing atmosphere and no solid reductants.

265. PHAN-KUAN, D.: Thermodynamics and thermokinetics of alumina solutions in cryolytic mixtures. Theses presented at the Université de Provence, Vol. 1. pp. VIII. /French/

The experiment with alpha- and gamma- aluminium solutions was effected by using microcalorimetry at high temperatures.

266. ROY, D. et alii: Some aspects of use of high-alumina bricks in blast furnaces in India. In: [Proc. Seminar] High-Alumina Refractories, Calcutta, May 1973. [1976] pp. 120-137.

An analysis of the use of high-Al₂O₃ bricks in Indian blast furnaces is followed by an attempt to outline the various modifications carried out as well as envisaged in the near future in the blast furnaces in India.

267. SUNDARAM, P. S. et alii: High-alumina refractories: application, service performance, and future requirement. In: [Proc. Seminar] High-Alumina Refractories, Calcutta, May 1973. [1976] pp. 138-146.

The use of high-Al₂O₃ refractory bricks in e.g. the sinter plant, blast furnace, rotary kiln, and reheating furnaces of the Rouckela Steel Plant, India, is described. Bricks various specifications were employed; their performance is discussed.

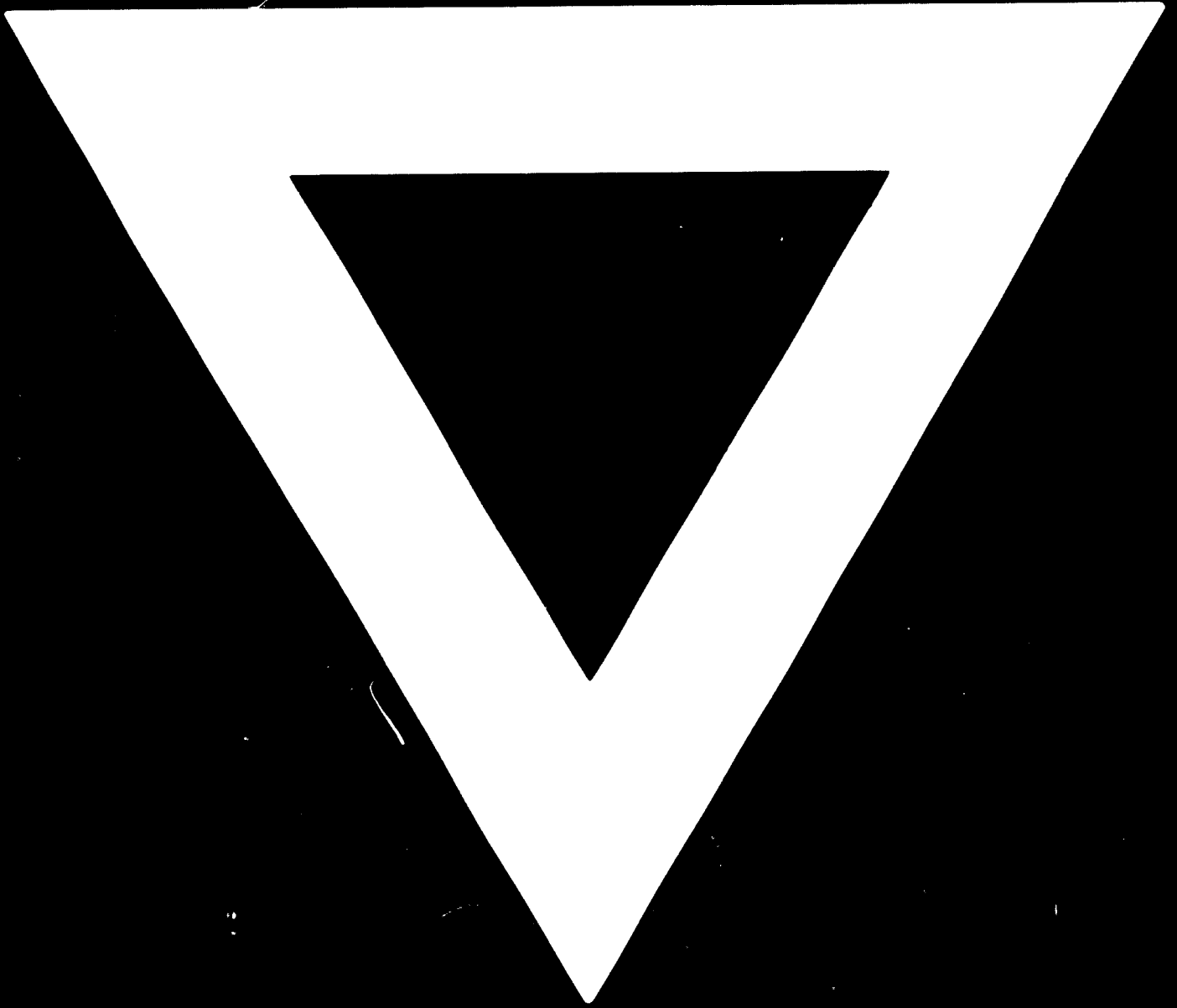
268. VARNER, J. R.; STOLZ, R.: Strengthening of alumina. Second International Conference on Mechanical Behavior of Materials, 1976. pp. 1761-1765.

Polycrystalline Al₂O₃ has been thermally strengthened by quenching from high temperature using a new process which eliminates failure due to thermal shock during processing. Specimens are soaked at the optimal temperature of 1550 and 1700° C for square and round rods, respectively, then dropped directly into the oil-emulsion quenching medium.

269. WARGALLA, G.: Utilization of red mud for the production of cement and expanded clay. Revue de l'Aluminium, No. 443. Sept. 1975. pp. VI. /French/

Due to its high hematite contents red mud is an interesting product for bringing about sintering. Among others, when producing cement, its main constituents function as regulators for the crystalline, hydraulic phases.

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