FOURTH EUROPEAN SYMPOSIUM ON COMMINUTION AND FIRST EUROPEAN SYMPOSIUM ON PARTICLE SIZE MEASUREMENT

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The Fourth European Symposium on Comminution and the First European Symposium on Particle Size Measurement were held in Nürnberg, West Germany, September 15-19, 1975. 40 papers were presented and discussed in the Comminution Symposium and 26 papers in the Particle Size Measurement Symposium in fifteen sessions.

Delegates totalled about 400; the largest group of delegates came from the host country, Federal German Republic.

It can be said that the theoretical papers were in the majority. One hopefully wishes to see a happy balance between the theoretical and practically oriented papers in the future symposia.

A review of the selected papers is divided into two main groups, namely, comminution and particle size measurement. Full titles in the original language and authors are given in the references at the end of the article.

1. PAPERS ON COMMINUTION

1.1. General papers

The main part of the paper given by H.Rumpf (1) has dealt with the comparison of expenses in comminution processes. The overall energy consumption for comminution can be estimated to be 3-4 % of the total electric power consumption.

C. J. Stairmand (2) has given a review on the fundamental mechanism of size reduction. In practice, energy losses in the present mills are such that the efficiencies range from less than 1 % for fluid energy mills, to over 80 % for roll crushers; ball and roller mills, on which the majority of industrial comminution is carried out, have efficiencies in the range of 7-13 %.

Environmental aspect of comminution has been discussed in a paper given by H.Sillem (3).

The grinding of polymers has been presented by K.Schonert (4). The difficulty is experienced to grind polymer powders because of the visco-elastic and temperature sensitive material behaviour.

R. J. Testut (5) has discussed the grinding circuits applied in the mineral industries. The choice of the grinding circuit is a compromise, taking into consideration investment cost, operation costs and the ground product. The autogenous grinding circuits have had spectacular application on hard and abrasive ores, where they have justified lower investment costs and savings on ball consumption.

1.2. Basic principles of comminution

H.G. Ellerbrock (6) has reviewed grindability tests on cement clinker, quartz, and limestone with the Zeisel grindability tester and a semi-technical laboratory ball mill 0.63x0.63 m.

1.3. Control and On-Line-Process

The paper from Finland (7) has introduced the audiometric control system of comminution at the concentration plant of Outokumpu Oy, Vuonos mine. A new instrument has been developed for selective measurement of the noise emitted by the mill and this information has been found sufficient to serve as the basis for an automatic computer control system.

The particle size distribution of a cement powder can be measured by evaluation of the diffraction pattern that is observed when this powder is dispersed in a laser beam. This device is tried for continuous process control of cement mills (8).

1.4. Grinding machines and plants

R.T. Hukki (9) has discussed the methods to improve the performance of the closed grinding circuit. First, the sharpness of size separation must be increased while maintaining a reasonable high circulating load. Second, a two-step sizing process must be applied including a hydrocyclone followed by a screen to separate misplaced fines from the cyclone sand product.

Z.M. Doğan (10) has explained the application of autogenous grinding to quartzite, copper ore, and copper slag in Turkey. Autogenous system has been practiced successfully with quartzite and copper slag.

Particle size distribution for different ores and grinding systems have been studied in Sweden with measurements down to 2 microns (11).

1.5 Mathematical models

The paper given by L.G. Austin, P.T. Luckie, and H.M. v. Seebach (12) has presented a mathematical model based on the concepts of specific rates of breakage and residence time distributions for a full-scale finish data from a full-scale mill.

A computational study has been carried out to determine the appropriateness of lumped parameter approximations to the behavior of an open circuit grinding process (13).

Experimental data were obtained on a closed circuit wet grinding ball mill at the Frank Concentrator of Rustenburg Platinum Mines (14).

The paper presented by D.W. Fuerstenau (15) describes the results of dry grinding limestone in ball mill of three different diameters, namely 5 inches (12.7 cm), 10 inches (25.4 cm), and 20 inches (50.8 cm). Breakage functions were found to be independent of mill diameter, ball load, and mill speed.

T. Tanaka (16) has pointed out that the design of tube mill should be made in the order: 1) the required capacity determines the optimum diameter, Do, 2) The diameter and the tensile strength of a material crushed along with some other parameters calculate the length of mill, L, 3) Driving power should be based on Do and L above.

2. PAPERS ON PARTICLE SIZE MEASUREMENT

2.1. General papers

C. Orr (17) has outlined acceptable methods for evaluating the surface area of non-porous particles and particles containing relatively large pores.

The combined effect of developments in data processing and optical processing promise a whole current trends and future developments are outlined in the paper presented by B.H. Kaye (18).

Physical principles for on-line methods of particle size analysis have been discussed by K. Leschonski (19).

2.2. Measurement of particle size distribution and surface areas

C. von Alfthan (20) has introduced a new method for particle size measurement, based on X-ray fluorescence analyzer.

A unit for the determination ot particle size distributions has been described by K.L. Metzger and K. Leschonski (21).

The paper by R.J. Akers *et al.* (22) has briefly reviewed the history of automatic microscope particle size analysis system and the development of a system for full computer analysis of images using a Quantimet 720 Image Analysing Computer as the scanner.

The paper from the U.S.A. (23) has described the application of computer evaluation of scanning electron microscope images to the 3-dimensional particle analysis of 9 alumina powders.

B. Koglin (24) has discussed the settling velocity of the suspensions. The enhancement of the settling velocity in the interior of suspensions is due to cluster formation.

Experimental investigations of the sedimentation analysis of quartz in aqueous electrolyte solution have shown that the coagulation phenomena occurring during the sedimentation process lead to changes of the particle size distribution (25).

P.J. Lloyd (26) has pointed out experimental verification of the earlier assumption that the separations between particles passing through the orifice of a Coulter Counter follow the Poisson Distribution. R. Polke (27) has described a new Coulter Counter (Telefunken PVA or Coulter TF) for size distribution analysis. Advantages and disadvantages of the Couler Counter method have been explained by D. Seitert (28).

2.3. Dust measuring technology

R. Davies (29) has reviewed the methods that have been used for sizing raindrops, water sprays, atomizer sprays, nebulizer sprays, mist, fog, and cloud droplets.

P.G. Kihlstedt (30) has given a paper on the investigations that have been carried but with a new apparatus for measuring electrical charges on various materials ground in different ways.
Inquiries regarding ' the proceedings of the two symposia should be directed to: Prof. Dr. Ing. K. Schonert, Institiit fur Mechanische Verfahrenstechnik, Universitat Karlsruhe (TH), Postfach 6380, Bundes Republik Deutschland.

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2 — The Energy efficiency of milling processes, C.J. Stairmand.

3 — Zerkleinerungstechnik und Umweltschutz-Probleme und Moglichkeiten, H. Sillem.

4 — Das Zerkleinern von Polymeren, K. Schönert.

5 — Les circuits de broyage des industries minerales, R.J. Testut.

6 — Über die Mahlbarkeitsprvifung von Zementklinker, H.G. Ellerbrock.

7 — An audiometric control system for wet semi-autogenous grinding systems, H. Aurasmaa; M. Tarvainen; K. Saarhelo & P. Uronen.

8 — L'application de la diffraction laser au controle des broyeurs a ciment, P.P. Meric.

9 — About the ways and means to improve the performance of the closed grinding circuit, R.T. Hukki.

10 — Autogenous grinding practice in Turkey, Z.M. Doğan.

11 — Particle size distribution in different grinding systems, P.G. Kihlstedt.

12 — Optimization of a cement milling circuit with respect to particle size distribution and strength development by simulation models, L.G. Austin; P.T. Luckie & H.M. v. Seebach.

13 — A comparison of distributed and lumped parameter models for an open circuit grinding mills, J.A. Herbst, T.S. Mika, & A. Rajamani.

14 —Digital simulation of an industrial closed circuit wet ball milling system, R.K. Jaspan;H.W. Kropholler; T.S. Mika; & E. Woodburn.

15 — An investigation of the influence of mill size on the parameters of the batch grinding equation and on energy consumption in comminution, S.G. Malghan & D.W. Fuerstenau.

16 — Model of rate function applied to sizing and scale-up of cement tube mills, T. Tanaka.

17 — Surface area measurement—present status, C. Orr.

18 — The data processing revolution and the characterization of fine particles, B.H. Kaye.

19 — Die On-Line Verfahren der Teilchengrossenanalyse, K. Leschonski.

20 — A new method to determine mine particle size with on-stream X-ray slurry analyzers, C. von Alfthan.

21 — Untersuchung eines Querstromsichters zur On-Line Teilchen grossenanalyse, K.L. Metzger & K. Leschonski.

22 — Analysis of particle structure in packed beds using an automatic scanning system, R.J. Akers; P.J. Lloyd & B. Scarlett.

23 — Automated 3-dimensional SEM-characterization of alumina powders, W.R. Buessem; L. Tarhay & E.W. White.

24 — Zum Mechanismus der Sinkgeschwindigkeitserhohung in niedrig konzentrierten suspensionen, B. Koglin.

25 — Koagulationserscheinungen als Fehlerursache bei der Sedimentationsanalyse, C. Bernhardt.

26 — Coincidence effects on particle size analysis by Coulter counter, P.J. Lloyd.

27 — Vergleich des Partikelvolumen-analysators PVA mit anderen Methoden der Teilchengrossenanalyse, R. Polke.

28 — Anwendung des Coulter-Counter-Verfahrens zur Korngrossenanalyse bei der Kristallisation, D. Seifert.

29 — A review of the methods for the particle size analysis of droplets, sprays and mists, R. Davies.

30 — Distribution of electrical charges in mineral dust, P.G. Kihlstedt.