CRUSHING AND SCREENING MODELS FOR SIMULATION

by

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ABSTRACT

Accurate crushing and screening models are essential for the meaningful simulation of ore dressing plants such as the iron ore beneficiation plant studied in this work.

Crushing and screening models were studied, developed and enhanced. The basic simulator used was Microsim, which was subsequently expanded to incorporate these new models. The models were then evaluated individually. The Whiten crushing model was modified for haematite, as this is a particularly hard ore. A new model was developed for the gyradisc crushing of haematite, with two interparticle breakage mechanisms taking place in the crushing chamber. The gyradisc model has only the crusher closed side setting as parameter. Both models showed good agreement with experimental data. The Karra screen model was enhanced to include the use of 'poly' decks and non-square screen apertures, as used on the plant. The Rose efficiency model was developed to use efficiencies from plant data or experiments. The Rose model showed a better relative accuracy than the entirely empirical enhanced Karra model. The screen models developed can be used for different ores but the crushing models are not transferable.

Thereafter simulation was done for the quaternary sub-plant manufacturing two or three products respectively. The product ratios obtained by simulation were accurate in both cases. The optimisation routine was then used to calculate an improved fine to lumpy ore ratio. It was found that only a small improvement could be achieved in the quaternary plant. Simulation of the preliminary comminution plant, however, failed to give accurate results. This plant does not operate in steady state, therefore the error could be ascribed to this. The accuracy of the Nordberg gyratory crushing model used in this sub-plant could not be established. The washing and screening plant was successfully simulated with the new screening models.

The choice of size classes was found to be very important in the simulation of crushing and screening circuits. The maximum number must be used and should coincide with screen apertures. Microsim has proved to be a powerful simulator subject, to the quality of input data and evaluative skills of the user.

SAMEVATTING

Betroubare breker- en sifmodelle is noodsaaklik vir die betekenisvolle simulasie van ertsbereidingaanlegte, soos die ystererertsveredelingsaanleg wat hierin bestudeer is.

Breker- en sifmodelle is bestudeer, ontwikkel en verbeter. Die basiese simulator wat aangewend is, is Microsim, wat vervolgens uitgebrei is om nuwe modelle te inkorporeer. Die modelle is individueel geëvalueer. Die Whiten brekermodel is gewysig vir hematiet, aangesien dit 'n besondere harde erts is. 'n Nuwe model vir gyradisc vergruising van hematiet is ontwikkel, waarvolgens twee interpartikel breekmeganismes in die brekerkamer plaasvind. Die gyradisc model het slegs toekantstelling as parameter. Albei modelle toon goeie ooreenstemming met eksperimentele data. Die Karra sifmodel is uitgebrei om die gebruik van 'polydekke' en nie-vierkantige openings in te sluit. Die Rose effektiwiteitsmodel is ontwikkel om aanleg- of eksperimentele sifeffektiwiteite te kan gebruik. Die Rose model toon 'n beter relatiewe akkuraatheid as die empiriese uitgebreide Karra model. Die sifmodelle kan vir verskillende soorte ertse gebruik word, maar breker-modelle is nie oordraagbaar nie.

Hierna is simulasie vir die kwaternêre subaanleg, waar twee of drie produkte vervaardig word, uitgevoer. Die produkverhoudings verkry deur simulasie is akkuraat vir albei gevalle gevind. Die optimeringsroutine is aangewend om 'n verbeterde fyn tot stukerts verhouding te verkry. Slegs 'n klein verbetering is in die kwaternêre aanleg verkry. Simulasie van die voorvergruisingsaanleg het nie akkurate resultate gelewer nie. Hierdie aanleg funskioneer nie in die gestadigde staat nie, gevolglik kan die fout hieraan toegeskryf word. Die akkuraatheid van die Nordberg wentelbrekermodel wat in die subaanleg gebruik is, kon nie bepaal word nie. Die was- en sifaanleg is suksesvol gesimuleer m.b.v. die nuwe sifmodelle.

Die keuse van klasgroottes is baie belangrik in die simulasie van vergruisings- en sifaanlegte. Die maksimum aantal klasse moet gebruik word en moet ooreenstem met sifopenings.

Microsim is 'n kragtige simulator en sinvolle aanwending is onderworpe aan die kwaliteit van die toevoerdata en die oordeel van die gebruiker.

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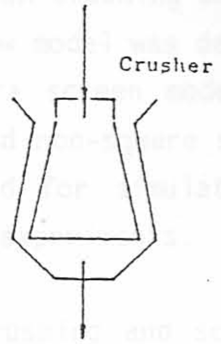
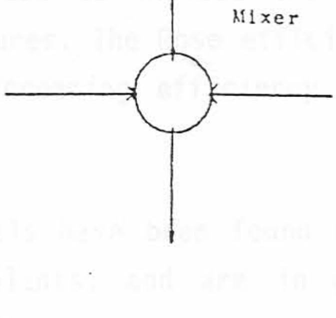
LIST OF SYMBOLS AND ICONS

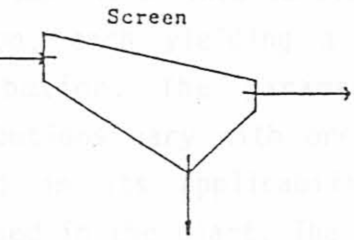
SYMBOLS

BC	Broadbent-Callcott
CCP	Coarse cyclone plant
CDP	Coarse drum plant
CSS	Closed side setting
d50	Separation size
Epm	Ecarte probable moyen
F	Fine ore product
FCP	Fine cyclone plant
IWI	Impact work index
L	Lumpy ore product
MDP	Medium drum plant
OSS	Open side setting
RR	Rosin-Rammler
SP1	Sub-plant 1: Preliminary comminution of run-of-mine
SP2	Sub-plant 2: Washing and screening plant
SP3	Sub-plant 3: Beneficiation plants (CCP, CDP, FCP, MDP).
SP4	Sub-plant 4: Quaternary crushing and screening plant

ICONS


Crusher


Mixer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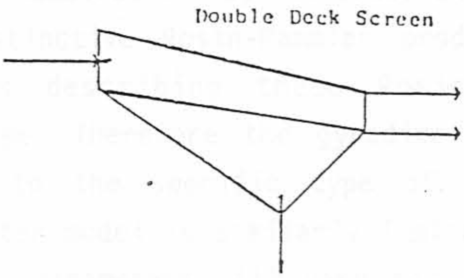
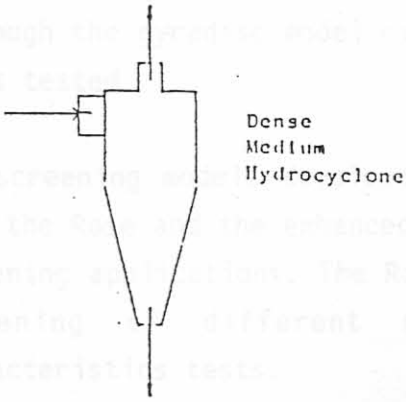
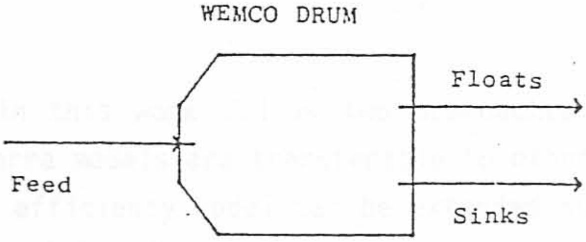

Double Deck Screen


Dense
Medium
Hydrocyclone


WEMCO DRUM
Floats
Feed
Sinks