Proceedings of International Seminar on
Mineral Processing Technology (MPT-2001)
February 15-17, 2001, Hyderabad (India)

Editors
N. P. H. Padmanabhan
T. Sreenivas
K. Srinivas

Allied Publishers Limited
New Delhi, Mumbai, Kolkata, Chennai, Nagpur;
Ahmedabad, Bangalore, Hyderabad, Lucknow
# Contents

Preface ix

Challenges and Opportunities in Mineral Processing in India in the New Millennium

*Presidential Address*

## THEME 1: CHARACTERISATION

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Development of Fine Grinding Machines — Eccentric Vibratory Mill and Centrifugal Tube Mill</td>
<td>7</td>
</tr>
<tr>
<td>V. Vogt, E. Gock and R. Florescu</td>
<td></td>
</tr>
<tr>
<td>Mineralogical and Geochemical Characteristics of Intrusive Bodies and their Metamorphic; SW of Yazd, IRAN</td>
<td>12</td>
</tr>
<tr>
<td>Reza Zarei Sahamieh and Amir Pazoki</td>
<td></td>
</tr>
<tr>
<td>Mineral Chemistry of Belah Phosphate Ore and its bearing on Environment</td>
<td>22</td>
</tr>
<tr>
<td>A. Chattopadhyay, B. Banerjee and S. C. Maulik</td>
<td></td>
</tr>
<tr>
<td>Techniques of Mineralogical Characterisation of Bentonitic Clay for Industrial Application</td>
<td>25</td>
</tr>
<tr>
<td>Mohan Ram, A. Nagaraja and S. K. Ghosh</td>
<td></td>
</tr>
<tr>
<td>A Modified Method for Mineralogical Estimation of Phosphorites: A Case Study of Jhamarkotra Phosphate Deposit, Rajasthan, India</td>
<td>31</td>
</tr>
<tr>
<td>T. S. Sunil Kumar and D. Narasimhan</td>
<td></td>
</tr>
<tr>
<td>Estimation of Iron in High Purity Calcite by Atomic Absorption Spectrophotometry</td>
<td>34</td>
</tr>
<tr>
<td>A. S. Navale, N. Balachandran, R. R. Venkitakrishnan and K. Sivaramakrishnan</td>
<td></td>
</tr>
<tr>
<td>X-ray fluorescence determination of Al, Cl, Hf, K, and Zr in molten salt separation process of zirconium and hafnium</td>
<td>37</td>
</tr>
<tr>
<td>H. R. Ravindra, V. Vijayalakshmi, G. Radhakrishna, B. Gopalan and S. Syamsundar</td>
<td></td>
</tr>
<tr>
<td>Potassium Pyrosulphate-A Solid Solution Technique for the Analysis of Various Ores Minerals and Ore Dressing Products by X-Ray Fluorescence Spectrometry</td>
<td>40</td>
</tr>
<tr>
<td>B. S. Moroney, S. R. Bhaisare, S. K. Ghosh and K. S. Raju</td>
<td></td>
</tr>
<tr>
<td>Simple Microwave Technique for Estimation of Metal in its Ores through dielectric Measurement of Mainpat area of Chhattisgarh</td>
<td>46</td>
</tr>
<tr>
<td>S. K. Srivastava</td>
<td></td>
</tr>
<tr>
<td>Assessment of Liberation Size of Calcareous Graphite Ore of Shivaganga Area, Madurai Dist., Tamil Nadu</td>
<td>49</td>
</tr>
<tr>
<td>M. R. Patil, K. S. Shivakumar and R. Bhima Rao</td>
<td></td>
</tr>
<tr>
<td>Micronization and Air Classification: An Emerging Technology for Quality Up-gradation in Mineral Processing Industries</td>
<td>55</td>
</tr>
<tr>
<td>K. Kumar Vyas</td>
<td></td>
</tr>
</tbody>
</table>

## THEME 2: COMMUNICATION AND CLASSIFICATION

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative Performance Study on a 100 mm Water-Injection Cyclone and a Hydrocyclone</td>
<td>63</td>
</tr>
<tr>
<td>Asymptotic Similarity Solution to Integro-differential Equation for Batch Grinding</td>
<td>68</td>
</tr>
<tr>
<td>B. Venkoba Rao, N. P. H. Padmanabhan and K. Lakhminarayana Bhat</td>
<td></td>
</tr>
<tr>
<td>Studies on Flow Field Inside a Light Phase Hydrocyclone for Oil/Water Separation on North Sea Platform</td>
<td>72</td>
</tr>
<tr>
<td>P. Bhattacharyya</td>
<td></td>
</tr>
</tbody>
</table>
THEME 3: PHYSICAL SEPARATION & MODELLING AND SIMULATION

Performance Analysis of two Centrifugal Techniques for Separation of Graphite from a Lead Concentrate

Prospects of Dry Beneficiation of Coal by Selective Magnetic Coating

Dry Beneficiation of Limestone Using ‘V-stat Triboelectric Separator’
S. Chakravorty, Jyoti Srivastava and V. J. Anantharaman

Modeling of Biooxidation of a Refractory Gold Concentrate
M. N. Chandraprabha, J. M. Modak, A. M. Raichur and K. A. Natarajan

Self-Similarity in Hydrocyclone Performance
B. Venkoba Rao

Characterisation and Beneficiation of Niobium Minerals from the Soils of Samchampi Carbonatite Complex, Mikir Hills, Assam, India
S. Q. Hoda, K. Viswamohan and R. P. Sinha

THEME 4: FLOWSHEET DEVELOPMENT

The Beneficiation Studies of Barite Deposits from Mehdi Abad Area of Iran
B. Rezai

Bench Scale and Pilot Scale Studies on the Beneficiation of Subgrade Magnesite of Salem for Refractory Applications

Beneficiation of Low Grade Tungsten Ore from Degana, India
R. Singh, K. K. Bhattacharyya, J. P. Srivastava, B. Banerjee and S. C. Maulik

Development of Process Flow Sheet for High Pyrrhotite Lead-Zinc Ore from Sindesar-Khurd
G. G. Tarnekar and C.P. Porwal

Beneficiation of a ROM Graphite Sample from Shivaganga Area, Tamil Nadu
T. H. Banerjee, M. V. Rao, K. G. Ingle, A. Majumdar and M. N. Makode

Beneficiation of Silica Sand for Glass Industries
Sabu Joseph, Jacob P. George and C. M. Mani

Study on Superconcentration of Blue Dust Sample
S. K. Sil, K. K. Bhattacharyya, B. Banerjee, J. P. Srivastava and S. C. Maulik

Studies on The Recovery of Chromite Values from Slime Using Statistical Design of Experiment

Advance Process Flow Sheet for Beneficiation of Low Grade Graphite Ore
S. K. Biswal and A. K. Sahu

Beneficiation Characteristics of Pegmatitic Gravel From Chellanpara Area, Bastar District. Chattisgarh, India

THEME 5: BIOPROCESSING

Development of Adapted Strains of *Thiobacillus ferrooxidans* for Bio-oxidation of Refractory Gold Ores
H. Sarvamangala, A. M. Raichur, J. M. Modak and K. A. Natarajan

Effect of Ionic Strength in Determining Adhesion of *Bacillus polymyxa* on to Hematite and Quartz
A. R. Shashikala and A. M. Raichur
Effect of Bacterial Interaction with *Thiobacillus ferrooxidans* on the Floatability of Sphalerite and Pyrite  
*R. J. Deshpande, S. Subramanian and K. A. Natarajan*  
159

Microbial Degradation of Typical Flotation Reagents Using *Bacillus polymyxa*  
*Evvie Chockalingam, S. Subramanian and K. A. Natarajan*  
162

Studies on the Bioremoval of Hexavalent and Trivalent Chromium using *Bacillus polymyxa*  
*Hemamalini Thyagarajan, S. Subramanian and K. A. Natarajan*  
166

Bioprocessing of Ocean Manganese Nodules For Recovery of Copper, Nickel and Cobalt  
*Abha Kumari and K. A. Natarajan*  
170

Leaching of Chalcopyrite Ore Using Thermophilic Bacteria  
*Asha Gupta and Kumar Birendra*  
174

Bio-separation of Galena and Sphalerite Minerals using *Bacillus polymyxa*  
*D. Santhiya, S. Subramanian and K. A. Natarajan*  
176

**THEME 6: SURFACE CHEMISTRY AND FLOTATION**

Role of Mixed Cationic/Anionic Collector Systems in Selective Feldspar Flotation from Quartz  
*A. Vidyadhar, K. Hanumantha Rao and K. S. E. Forssberg*  
183

Flotation of Titaniferrous Impurities from Kaolin - Effect of High Shear Dispersion and Conditioning  
*P. Raghavan, V. Chandrasekhar, V. Vogt and E. Gock*  
192

N-Arylhydroxamic Acids as Mineral Collectors for Ore-Beneficiation  
*R. Natarajan and I. Nirdosh*  
196

Dispersion Studies on Apatite and Magnetite Fines using various Inorganic and Organic Reagents and their Influence on the Dephosphorization of Magnetite Ore  
*S. Subramanian, K. Hanumantha Rao and K. S. E. Forssberg*  
200

Evaluation of Process Variables in the Flotation of Rajpura-Dariba Lead-Zinc Ore Using Statistical Techniques  
*Kalyan K Das, Pradip, J. K. Mahamwal, V. P. Kohad and R Rangarajan*  
204

Recovery of Carbon Values from Blast Furnace Dust by Flotation Techniques  
208

Effect of Temperature on Fatty Acid Flotation  
*Amanullah, S. K. Ghosh and K. S. Raju*  
213

Beneficiation of Lead Zinc Ore Sample - A Modified Approach  
216

Studies of Electrokinetic Potential of Limestone and its Flotation Characteristics  
*Shobhana Dey and D. M. Chakrabarti*  
221

Selective Separation of Calcite from its Mixture with Apatite using Hydroxamate Collectors  
*T. K. Rao, Beena Rai, Pradip*  
226

**THEME 7: HYDROMETALLURGY**

Leaching of Manganese Ore by Sago Industry Effluent  
*B. R. V. Narasimhan, K. Selvakumar, L. Arokiadoss and T. S. N. Sankara Narayanan*  
233

Application of Forward Integration Method for the Recovery of Tungsten Values from a Tin-Tungsten Multi-Mineral Ore  
*T. Sreenivas, K. Srinivas, R. Natarajan and N. P. H. Padmanabhan*  
237
Study on Upgrading the Quality of Lead Concentrate by Reducing the Bismuth Content—A Possible Approach
P. K. Arya, Baby Prasad, K. K. Ganguly and C. Bandopadhy

Kinetics of Alkaline Leaching of Uranium Ore from Gogi, Karnataka, India
K. Anand Rao, A. S. Navale, K. C. Rajan, M. Manmadha Rao, N. Balachandran,
T. S. Sunil Kumar, S. K. Shukla and N. P. H. Padmanabhan

Uranium Recovery from Secondary Sources
S. L. Mishra, A. B. Giriyalkar, and H. Singh

Xenotime Concentrate Processing for Separation of Rare Earths, Uranium and Thorium
U. Sridhar, S. L. Mishra, A. B. Giriyalkar and H. Singh

Laboratory Studies on Pressure Leaching of Graphite Flotation Concentrate of Tapaskonda Wolframite Material
P. V. J. Annaji Rao and M. K. Dhar

THEME 8: WASTE MANAGEMENT AND ALLIED TOPICS

Processing Iron Ore Slime of Kiriburu Mines
S. K. Pan, M. P. Srivastava, N. Prasad and R. Venugopal

Recovery of Chromite from the Dumps by Beneficiation Techniques
K. V. Rao, R. K. Kunwar and S. C. Maulik

Recovery of Iron Values from Limonitic Dumps of Goa Region (India) Adopting Mineral Processing Techniques

Red Mud – A Major Pollutant in Aluminium Sector
S. N. Sinha, M. K. Agrawal, R. B. Prasad and S. B. Prasad

Plant Auditing for Improving Metallurgical Performance and Cost Reduction at Zawar Mines
V. P. Kohad

Recent Developments in Bulk Solids Flowability Technology Help Troubleshooting of
Existing Silos and Designing of Reliable Gravity Flow Mass - Flow System for Future Plants
Sanjeev Singh, V. Viswanadhan, V. L. Rao, and Suresh Chandra

Zero Waste in Utilization of Mine Waste
T. P. R. Chary and B. S. S. Rao

Index of Authors