



Annual Report

2020-2021



Institute of Mining, Mineralogy and Metallurgy (IMMM)

Bangladesh Council of Scientific and Industrial Research (BCSIR)

Science Laboratory Road, Khanjanpur, Joypurhat-5900

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Message from the

Chairman

Bangladesh Council of Scientific and Industrial Research (BCSIR)

Institute of Mining, Mineralogy and Metallurgy (IMMM), one of the prestigious entities of Bangladesh Council of Scientific and Industrial Research (BCSIR) has successfully completed its journey for the year 2020-2021. Consequently, it is a great contentment for me to know that IMMM is presenting its 'Annual Report 2020-2021' when we are celebrating the birth centenary of our great leader, Father of the Nation Bangabandhu Sheikh Mujibur Rahman.

IMMM is unique of its type in the country which was established through the successful materialization of an Annual Development Program (ADP) of the government and was formally inaugurated by the Honorable Prime Minister Sheikh Hasina on 22 January 2012. I extend my profound gratitude to our Honorable Prime Minister for all her support in establishing such a distinctive research institute. I also express sincere gratefulness to our Honorable Minister Architect Yeafesh Osman, Ministry of Science and Technology for his enthusiastic support to run this institute smoothly.

The get-up-and-go of IMMM to accomplish praiseworthy tasks during the fiscal year 2020-2021 was undoubtedly extensive. Indeed, since inception the contribution of IMMM particularly in the pitch of Research and Development (R&D) have always been rated excellent. It must be mention here that to strengthen the R&D sector, IMMM has explored research activities with numerous prestigious international research institutions, such as CSIRO Melbourne (Australia), CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT) Bhubaneswar, Odisha (India), and Korean Institute of Geosciences and Mineral Resources (KIGAM) (Korea). Besides conducting regular R&D activities, this single-tracked research entity is also mandated to provide analytical services, training programs and supervise research students of different universities for their higher degrees.

This Annual Report 2020-2021 is a summative document which covers each and every single attempts accomplished by the scientists of IMMM over the period 2020-2021. I am confident that this report will satisfy you providing ample information which are of relevance to the mining, mineralogy and metallurgy sectors.

I thank the Director, Scientists, Engineers and all workforces of IMMM who are, right through the year, associated with the championship ride of this unit. I specially thank the publication team for their contribution in bringing out this well-produced annual report. Last but not least, I sincerely hope that IMMM will continue its mission for stimulating and strengthening the R&D sector of BCSIR.

I wish its great success.

Joy Bangla, Joy Bangabandhu

(Professor Dr. Md. Aftab Ali Shaikh)



Message from the

Director (In-charge)

Institute of Mining, Mineralogy and Metallurgy (IMMM)

Bangladesh Council of Scientific and Industrial Research (BCSIR)

I am delighted that the Institute of Mining, Mineralogy and Metallurgy (IMMM), BCSIR, Joypurhat is going to publish its annual report for the period 2020-2021. In the area of mining, mineralogy and metallurgy, this institute is unique. The report includes several activities of this tenure, such as Research and Development (R&D) activities, processes and patents, publications, student guidance and other efforts of the scientists and engineers.

It is my privilege to note that the annual report on the activities of IMMM for the period 2020-21 is ready for publication. The mission of IMMM is to carry out, promote and guide scientific, industrial and technological research using various raw materials, gangue and ore minerals for developing processes, patents and scientific publications that optimize the economic, environmental and social benefits for the people of Bangladesh. Different scientific conferences and training programs help enhance the knowledge and expertise of scientists. I believe that a concise presentation of all research activities in multidisciplinary research areas would be beneficial for industrialists and entrepreneurs.

I appreciate the editorial committee members who made this report a success. I express my heartiest thanks to the scientists, engineers and all other staff who put their best efforts into the nation through their relevant work.

Lastly, I express my gratitude to the Chairman of BCSIR for his encouragement in the preparation of this report.

Joy Bangla

(Dr. Mohammad Nazim Zaman)

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INTRODUCTION

The Institute of Mining, Mineralogy and Metallurgy (IMMM) is one of the leading wings of the Bangladesh Council of Scientific and Industrial Research (BCSIR). It was established to grow up not only for the sustainable economy of Bangladesh but also for taking part in the journey of making Bangladesh a developed country. Though it is a multidisciplinary operating unit, its major research activities are related to containing mining, mineralogy and metallurgy fields. Previously, it was a development project of BCSIR starting in 2001 funded by the Ministry of Science and Technology and established in Joypurhat after having acquired about seven acres of land with other infrastructures from Joypurhat limestone and cement factory project of Petrobangla. After completion of the project in March 2009, the institute turned to a revenue budget with freshly appointed employees in June 2010. A total of fifty employees are working, out of which eleven are scientists and engineers.

Honourable Prime Minister of the People's Republic of Bangladesh Sheikh Hasina inaugurated this institute on 22nd January 2021. The Honourable Prime Minister expressed her satisfaction with the R&D activities of IMMM and inspired the personnel to take modern instrument based applied research projects to develop the science and technology innovation system of Bangladesh. She urged the scientists to expose their research findings to the nation and build up technological innovation using natural resources so that Bangladesh could reach a level of economy in the world.

IMMM is the one and only research organization in Bangladesh that conducts research in the field of mining, mineralogy and metallurgy in Bangladesh. The following research, development and innovation competencies exist within the unit (1) Mining Division (2) Mineralogy Division (3) Metallurgy Division.

The function of the institute are as follows:

- To conduct research on mining, mineralogy and metallurgy fields to enhance the BCSIR activities.
- To exploit the mineral deposits and carry out research on the innovation of commercial and exportable industrial products from the exploited mineral/ore deposits of the country.
- To carry out advanced research on mineralogy and develop mineral processing systems from the promising minerals/ores.
- To develop metallurgical processes and advanced technology for establishing various industries in the country i.e. agricultural tools, automobile parts, shipbuilding spare parts, composite manufacturing industry etc.
- To enhance the laboratories and research facilities within the field of mining, mineralogy and metallurgy.
- To provide training facilities for the development of manpower and upgrading working knowledge of the workers of mining, mineralogy and metallurgical industries.
- To provide research facilities/higher studies to the Universities, government and non-government organizations.
- To provide technical assistance to the material processing metal industries.
- To render analytical and testing services to the materials metal product industries for their raw materials and finished products.

Mission: Conducting mining, mineral processing and metallurgical research activities, process and technology development, promote industrialization and employment generation and thus achieving socio-economic development of the country and nation.

Vision: Utilization of minerals and materials resources of the country in industrialization by indigenous technology.

RESEARCH AND DEVELOPMENT (R&D) ACTIVITIES

MINING DIVISION

Mining is the extraction of valuable geological materials from the earth, usually from an ore-body, vein or coal seam. The mining division of IMMM is engaged in research work on mine planning designing to develop mine fields and solve mine based industrial problems including support design, water management, subsidence etc. This division has initiated advanced research and developed newer scientific solutions to the problems in the mining sector. Identification and characterization of mine products in order to make the best use of them in industrial sectors. This division is also engaged to help the public and private organizations with different issues in the mining sector.

3D SUBSURFACE MODEL GENERATION IN BARAPUKURIA COAL MINE AREA

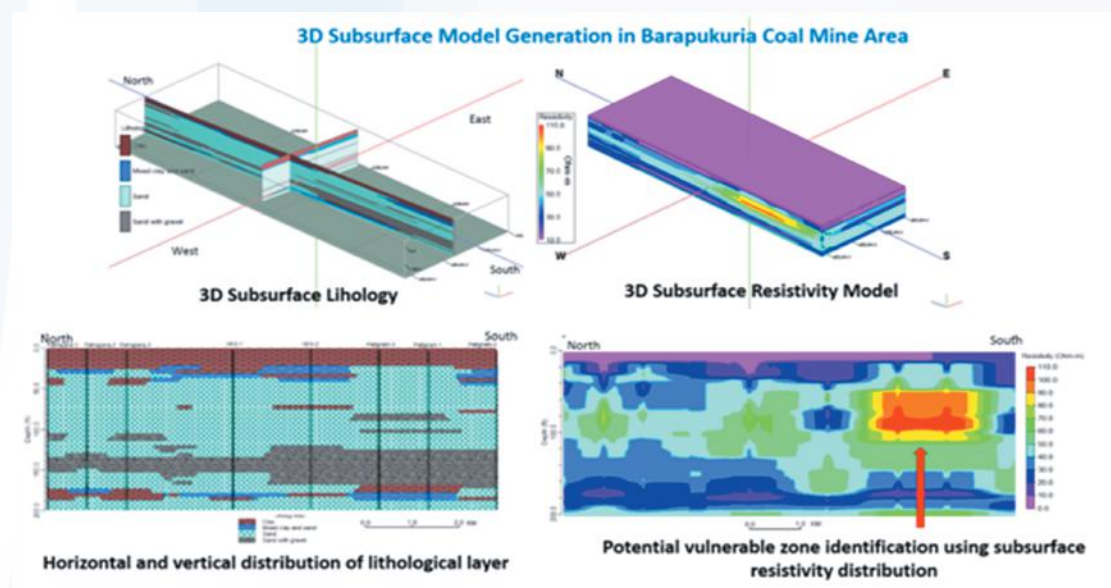
Md. Imam Sohel Hossain, Md. Sha Alam, Dr. Pradip Kumar Biswas, Dr A.S.M. Woobaid Ullah

Duration: July 2020 - June 2022

Brief Description: Underground coal mining operations and land subsidence are very frequent and interrelated events around the mining area in the world. It is well known that coal itself is a less competent rock as well as it is overlying strata. In the case of the Barapukuria Coal Mine, the characteristics of coal are highly volatile and bituminous where this coal-bearing formation stratigraphically exists below the Dupi Tila water-bearing formation, naturally vulnerable to have subsidence incidents in the area. Moreover, the environmental impacts caused by coal mining subsidence become increasingly serious, threatening the ecological safety in the mining area. Consequently, the environmental pollutions by subsidence create a significant communal problem.

Though the impacts of subsidence on structures and the environment have been examined by many researchers, unluckily the research on the 3D subsurface stratigraphic model of the mining subsidence area using noninvasive geophysical methods are still missing, even if the subsidence-induced environmental threats create a critical barrier to sustainable coal extraction from this mine as well as the development of other coal minefields in Bangladesh. For these reasons, the mining subsidence and its impacts on different components of the environment are much needed to be carefully examined and monitored in the area.

Objective: The objective of this research is to use geophysical methods to generate a 3D subsurface model of the Barapukuria coal mining area which will help us to identify the potential hazard zone below the subsurface and solve mining, engineering and many environmental impacts related problems.



Progress Achieved: The project is on going. Approximately 90% work has been completed till April 2022. After completion, a manuscript will be prepared for submission to a reputed indexed international journal having impact factor.

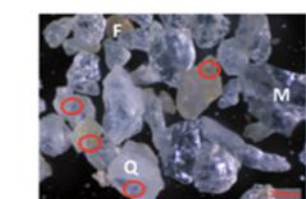
EXTRACTION OF HIGH-QUALITY GLASS MAKING SILICA FROM CHAUDDAGRAM SAND OF COMILLA

Md. Imam Sohel Hossain, Dr. Pradip Kumar Biswas, Dr. Modhu Shudan Saha, Dr Mohammad Nazim Zaman

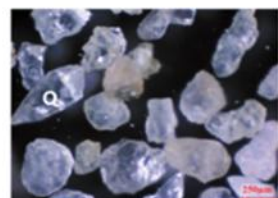
Duration: July 2019 - June 2021

Brief Description: A study has been carried out to assist the local glass sheet making industry located at Chattagram, in order to improve the quality of locally available silica sand sourced from Chauddagram, Cumilla. As the glass contains greenish colour and the final product is not satisfactory to consumers, an experiment has been implemented in our laboratory to investigate its quality. The primary microscopic, XRF and XRD analyses have been done to identify the major and minor phases present in the sample. It is found that the raw sample possesses about 67.75% of SiO_2 , and 11.25%, 0.74%, 6.21%, and 7.02% of Fe, Cr, Ti, and Al respectively whereas microscopic analyses confirm iron coating on the sand. After completing the primary analyses, gravity, magnetic and electrostatic plate separation were used to enhance its quality. Further microscopic, XRF, and XRD analyses were carried out to explore its quality. The result has revealed that the percentage of silica increases from 67.75% to 94%, whereas the minor phases such as Fe, Al, Cr, Ti reduce to 0.28%, 3.67%, 0.59% & 0.08% respectively. Sieve analysis was also done to examine the mesh size. It has shown that about 92% of grains fall under the specific requirement of the size range (35 to 120 mesh) of glass sand.

Objective: To separate pure silica from Chaddagram Sand.



Raw Sand of Chaddagram, Comilla (67.75% Silica)

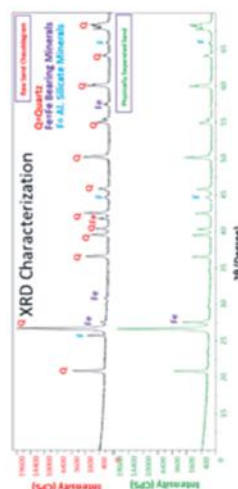


Physically Separated Sand (94% Silica)

XRF Characterization

Raw Sand	
Component	Weight %
SiO ₂	67.75
Fe ₂ O ₃	11.25
TiO ₂	6.21
Al ₂ O ₃	7.02
CaO	2.62
K ₂ O	2.26
Cr ₂ O ₃	0.74

After Physical Separation	
Component	Weight%
SiO ₂	94.2
Al ₂ O ₃	3.67
Fe ₂ O ₃	0.279
Cr ₂ O ₃	0.5926
TiO ₂	0.0845
CaO	0.0475



Progress Achieved: The project has been completed. After submitting the manuscript in a reputed indexed journal, some additional experimental queries have come. After fulfilling the queries, we will again submit the revised manuscript and optimistic for its publication very soon.

MINERALOGY DIVISION

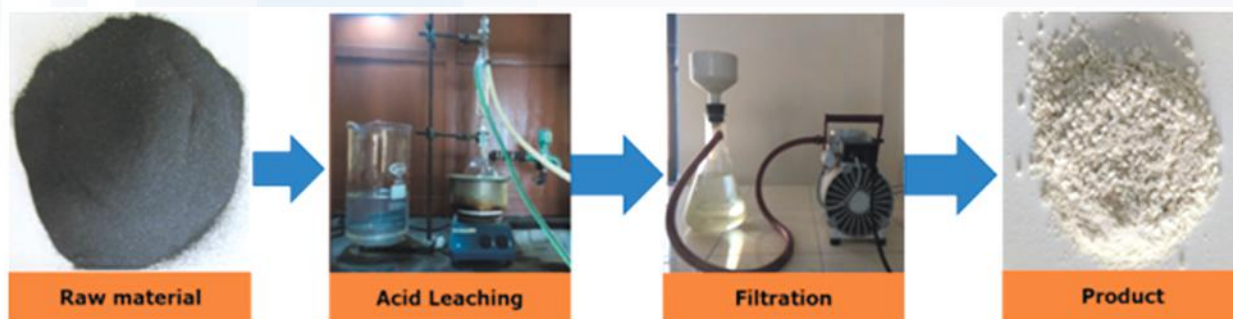
Mineralogy is an earth science focused on the chemistry, crystal structure, and physical properties of minerals. The division has initiated advanced research in the field of mineralogy and developed new science and technologies to help local and export-oriented industries. The scientists (geologists, mineralogists, and chemists) of this division are engaged in the exploration of indigenous mineral resources, characterization, reserve estimation, mineralogical and geological studies of the explored minerals and their industrial uses in order to substitute the imported raw materials used in the local industries.

PREPARATION OF SYNTHETIC RUTILE FROM ILMENITE OF BRAHMAPUTRA RIVER BASIN

Md. Shohel Rana, Dr Madhu Sudan Saha, Dr. Pradip Kumar Biswas, Md. Shams Shahriar

Duration: July 2019 - June 2021

Brief Description: Ilmenite is the main feedstock material used worldwide for synthetic rutile production. Synthetic rutile is a chemically modified form of ilmenite that has had most of the iron removed. The research was performed in two steps; firstly, the heavy mineral concentrated sample was collected from the Brahmaputra River and the separation of ilmenite from other heavies was accomplished chronologically by using a shaking table, IRMS and ESPs. The raw material, i.e., Brahmaputra River ilmenite contained the oxides of titanium 33.98% and iron 58.84% with other impurities (SiO₂, Al₂O₃, MnO etc.). The average size of ilmenite is 168 μm. The texture of ilmenite shows the presence of hematite bands within the ilmenite grains. Secondly, hydrometallurgical treatment of milled ilmenite was conducted in the laboratory for synthetic rutile preparation. The product obtained from this laboratory experiment was composed of 92.84% TiO₂, 4.42% Fe₂O₃ (total) and other oxides (2.74%). XRD and Raman spectroscopy confirms that the prepared product is similar to the rutile phase. The average size of prepared synthetic rutile is 4.49 μm. These upgraded products of ilmenite, i.e., synthetic rutile are used primarily in paints, plastics, ceramics and papers industries.



Objective: The objective of this research work was to develop a process for the preparation of synthetic rutile from locally available river ilmenite.

Progress achieved: The project has already been accomplished. A patent writing is ongoing for submission.

FORMULATION AND PRODUCTION OF SILICON CARBIDE (SiC) BASED ABRASIVES FROM LOCALLY SOURCED RAW MATERIALS IN BANGLADESH

Md. Sha Alam, Dr. Mohammad Nazim Zaman, Dr. Pradip Kumar Biswas, Dr. Madhu Sudan Saha

Duration: July 2019 - June 2021

Brief Description: Abrasive materials are materials of extreme hardness that are used to shape other materials by a grinding or abrading action and they are used either as loose grains, as grinding wheels, or as coatings on cloth or paper. This research has been conducted on the formulation and manufacture of silicon carbide and abrasive materials using locally available raw materials. Quartzite and river sand is used as a source of SiO_2 and for C locally available char has been used. A systematic search for an optimal formulation of silicon carbide abrasives was conducted using the Taguchi method. The mixture of SiO_2 and coal was fired in a furnace to $1400\text{-}1600^\circ\text{C}$ for 4-6 hours forming silicon carbide (SiC) chunks, which were crushed and sieved into coarse and fine grades and finally manufactured abrasive or grinding materials. XRD analysis of the produced material show poor formation of silicon carbide. On the other hand, manufactured grinding materials are subjected to some mechanical tests and the test results show that they conform within the range (poor to moderate) of values specified in the international standard handbook. Therefore further research should be conducted to upgrade the silicon carbide (SiC) abrasives as well as grinding materials.

Objective: To formulate and manufacture silicon carbide and abrasive materials using locally available raw materials such as quartzite, river sand and coal.

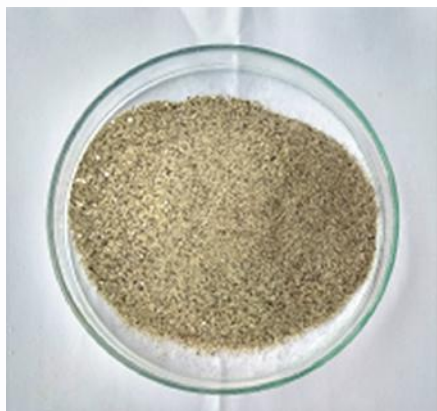
Progress achieved: The completion period of the project has already been end but the product upgradation work are still going on. If successfully upgrading the SiC and abrasive products a novel process will be submitted to BCSIR.

PREPARATION OF SYNTHETIC SILICA (SiO₂) NANO-POWDER USING RIVER SAND OF BANGLADESH

*Md. Shams Shahriar, Md. Shohel Rana, Dr. Pradip Kumar Biswas, Dr. Madhu Sudan Saha, Md.
Imam Sohel Hossain*

Duration: July 2019 - June 2021

Brief Description: Research has been conducted on the tailings of river sand which has been produced during the physical separation of heavy minerals from the Brahmaputra River. Silica (SiO₂) powder has been synthesized using the tailings (light minerals) from gravity separation by shaking the table from Brahmaputra river sand. The method of preparing silica nanoparticles from the tailings comprises: physical separation, washing the sand with HCl, solving the sand with sodium hydroxide to form sodium silicate, and neutralizing the solution with sulfuric acid to form a precipitate, washing, drying and grinding of silica powder. The light part of sand separated by the shaking table was analyzed in an XRF spectrometer, it contains about 81.6% of SiO₂ and 1.9%, 6.57%, 1.8%, 1.5% and 4.9% of Na₂O, Al₂O₃, CaO, Cr₂O₃, and Fe₂O₃t respectively. Upon completing the procedure the final results show that the above-mentioned method produces silica powder containing about 93% of SiO₂ with some minor phases. This research will provide scientific management of the tailings, which will ensure the maximum utilization of tailings and prepared nano-silica powder could be used in different industries.



Raw Sand



Product

Objective: Silica (SiO₂) powder synthesizing using the tailings (light minerals) from gravity separation by shaking table from Brahmaputra river sand.

Progress achieved: This project has already been accomplished. Working for a process is going on, shortly a process will be submitted to BCSIR.

PREPARATION OF SiO₂-TiO₂ BASED COATING FOR CONSTRUCTION MATERIALS

Md. Sha Alam , Md. Shams Shahriar, Md. Shohel Rana, Dr. Pradip Kumar Biswas

Dr Mohammad Nazim Zaman

Duration: July 2020 - June 2022

Brief Description: Among the different environmental-friendly technologies heterogeneous photocatalytic oxidation using TiO₂ has become an interesting technology due to its high photocatalytic and self-cleaning activities and has been used as a coating for various construction materials like metals, glassed building surfaces etc. Recently, the incorporation of TiO₂ (e.g., coatings or additives) into construction materials used in urban infrastructures, such as concrete and mortars, has been an interesting approach to reduce NO_x and VOCs (volatile organic compounds) at outdoor concentrations using sunlight as the only energy source; these are the so-called air purifying properties. However, its super-hydrophilic effect can easier to remove the fouling substances on TiO₂ loaded surfaces which are called self-cleaning ability.

Recent applications of photocatalytic building materials in urban pilot projects have demonstrated that maintaining the durability of the air-purifying and self-cleaning properties remains challenging, especially under outdoor conditions. Among other environmental factors, dust and oil accumulation have been reported as major factors affecting the properties of photocatalytic construction materials on an urban scale. In Bangladesh, available research information on the synthesis of photocatalytic coating for cement-based construction materials is still novel. However recently this type of coating materials is also being used in our country and market demand is increasing rapidly which is entirely fulfilled by importation at a higher cost.

Objective: Development of a SiO₂-TiO₂ coating in a cost-effective way that is applicable to cement-based construction materials, such as concrete and mortars.

Progress achieved: In this project SiO₂-TiO₂ composite coating have already been synthesized and coated on concrete and glass substrate. The numbers of characterization work have been done and some are going on. After completing the all of characterization a process and/or paper will be submitted to reputed journal.

METALLURGY DIVISION

Metallurgy is a domain of materials science that studies the physical and chemical behaviour of metallic elements, their inter-metallic compounds and their mixtures. The metallurgy division is engaged in research work on the development of efficient methods of materials processing and production to ensure the proper utilization of the various minerals/metals/ores found in Bangladesh. Researchers of this division conduct extensive research in the area of materials processing, extractive metallurgy, foundry technology, power metallurgy, composite material, and advanced ceramic engineering to meet the modern technological demand for advanced materials and to introduce newer methods to the industrial sectors, solve various metallurgical problems of the local metallurgical industries.

EXTRACTION OF ALUMINA FROM DIFFERENT TYPES OF CLAY OF THE BARIND AREA

Mst. Shanjida Sultana, Raduanul Islam Mridul

Duration: July 2020 - June 2021

Brief Description: Alumina (Al_2O_3) is an important industrial mineral and oxide which have a very wide range of applications. The demand for alumina and aluminium in the world is growing continuously. Several researchers have already reported about 60-90% alumina recovery from clay in different regions of the world. Clay minerals are considered to be the best available source of non-bauxite raw material for alumina production. Because clay minerals are abundant and have a relatively high grade of aluminium as well as clay mining is easier and require simpler preparation and enrichment processes.

In Bangladesh, different types of local clay (Kaolinite, illite, chlorite) are available in many areas in which aluminium oxide percentages are approximately 22-30%, providing a possibility to extract alumina which could be used in different industries. Aluminium oxide content in Barind clay (Northern area), which is mainly illicit type clay observed about 20- 22%.

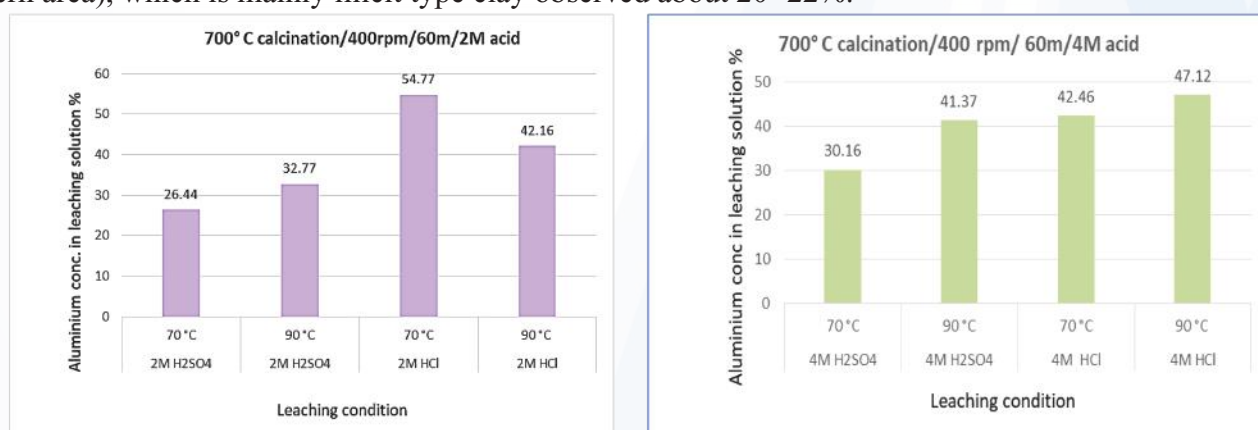


Figure: Aluminium recovery percentages from calcined clay with different leaching conditions

This research studied the possibility of extraction of alumina from Barind clay by acid leaching with sulfuric and hydrochloric acid at different concentrations, time, temperature and leaching speeds. The per cent of aluminium concentration is higher for HCl than H₂SO₄ in the leaching solution. The per cent of aluminium recovery from the calcined clay under the studied conditions reaches about 45-55 % in solution.

Objective: To recover Alumina and Aluminum from local clay (Kaolin, illite, chlorite).

Progress achieved: A manuscript is being prepared for submission to a reputed journal.

EXTRACTION OF PURE ZINC FROM STEEL-MAKING DUST IN BANGLADESH

Raduanul Islam Mridul, Dr. Madhu Sudan Saha, Md. Shams Shahriar, Dr Mohammad Nazim Zaman

Duration: July 2019 - June 2021

Brief Description of the project: Recovery of zinc from this dust with such a high percentage is an attractive option considering its low production cost. Industries can be set up using this raw material which can meet up the local demand of zinc and zinc related products. Thus new employment will be created. Dependency on foreign countries will be reduced since all the zinc and zinc related products are exported from foreign countries. The environment will be less polluted by this dust since metals from this dust can leach out to the surface and groundwater, contaminating the environment, thus the following accumulation in organisms such as plants and animals, reach humans. Since the metals do not decompose, they can bio-accumulate once they are absorbed.

The objective of the project: To utilize the steel making dust and recycle and to prepare zinc oxide and pure zinc for fulfill local demand.

Progress achieved: A manuscript is being prepared for submission to a reputed journal.

ACHIEVEMENTS AND OTHER ACTIVITIES

PUBLISHED/ACCEPTED ARTICLES (NATIONAL AND INTERNATIONAL):

1. Hossain, M.S., Woobaidullah, A.S.M. & Rahman, M.J. Reservoir characterization and identification of new prospect in Srikail gas field using wireline and seismic data. *Journal of Petroleum Exploration and Production & Technology* 11, 2481–2495 (2021). <https://doi.org/10.1007/s13202-021-01217-y>
2. Ali, S., Alam, M.S., Ahmed, S.S., Zaman, M.N., Hossain, I. & Biswas, P.K., 2019. Geochemical characteristics of recent sediments of channel bar of the Ganges (Padma) River, Bangladesh, *BANGLADESH GEOSCIENCE JOURNAL*, VOL. 25, P. 23-46. (April/21)
3. Islam, M.S., Ullah, S.M., Jolly, Y.N., Islam, M.A. and Biswas, P.K., 2021. Petrological, geochemical, and microfacies analysis of the Sylhet limestone, Bengal Basin, Bangladesh: implication for depositional environment and diagenesis. *Arabian Journal of Geosciences*, 14(1), pp.1-22. (March/21)
4. Hossain, M.S., Aziz, M.T., Shahriar, M. and Ritu, A.A., 2021. Heavy Mineral Analysis of Jamuna River Sediments, Bangladesh. *Journal of the Geological Society of India*, 97(5), pp.470-480.

5. Biswas, P.K., Alam, M.S., Hasan, A.S.M. M., Ahmed, S.S., Zaman, M.N., 2020. Geochemical signatures of recent bar deposits in Tista River, Bangladesh: Implications to provenance, paleoweathering and tectonics. *Journal of Nepal Geological Society*, 60, pp.1-20. <https://doi.org/10.3/26/jngs.v60i0.31272> (Feb/21)
6. Rahman, M.M., Hasan, M.F., Hasan, A.M., Alam, M.S., Biswas, P.K. and Zaman, M.N., 2021. Chemical weathering, provenance, and tectonic setting are inferred from recently deposited sediments of Dharla River, Bangladesh. *Journal of Sedimentary Environments*, 6(1), pp.73-91. Dec/20
7. Ahmed, M.T., Hasan, M.Y., Monir, M.U., Samad, M.A., Rahman, M.M., Rifat, M.S.I., Islam, M.N., Khan, A.A., Biswas, P.K. and Jamil, A.N., 2020. Evaluation of hydrochemical properties and groundwater suitability for irrigation uses in southwestern zones of Jashore, Bangladesh. *Groundwater for Sustainable Development*, p.100441. (Oct/20)
8. Rahman, M.A., Das, S.C., Pownceby, M.I., Tardio, J., Alam, M.S. and Zaman, M.N., 2020. Geochemistry of Recent Brahmaputra River Sediments: Provenance, Tectonics, Source Area Weathering and Depositional Environment. *Minerals*, 10(9), p.813. (Sep/20)
9. Md Khairul Islam, Michael Somerville, Mark I. Pownceby, James Tardio, Nawshad Haque, Suresh Bhargava, "Phase Equilibria Study of CaO-Al₂O₃-SiO₂-Na₂O Slags for Smelting Waste Printed Circuit Boards", *Pyrometallurgical Processing of Secondary Resources*, Springer, DOI: <https://doi.org/10.1007/s11837-021-04683-1>
10. Aninda Nafis Ahmed, Mst Shanjida Sultana, Mohammad Nazim Zaman and Md. Aminur Rahman. 2021. Influence of hard rock dust on the physical and microstructural properties of red ceramic materials. *Journal of Korean Ceramic Society*, 58, pp.69–76. <https://doi.org/10.1007/s43207-020-00085-2>

SUBMITTED SCIENTIFIC ARTICLES (NATIONAL & INTERNATIONAL):

1. Rana, M.S., Tasnim, T., Sayem, H.M. and Haque, M.E., Experimental study of 1-D Oedometer consolidation on some red clay soils of Pleistocene Barind Tract from Northern Bangladesh. *Innovative Infrastructure Solutions* (Submitted).

PUBLISHED CONFERENCE ABSTRACT/ ARTICLES:

1. Alam, M.S., Biswas, P.K., Alam, M.S., Ahmed, S.S., Zaman, M.N., Rana, M.S. and Shahriar, M.S. 2021. Feasibility study of physical separation for heavy minerals of the Tista river sand, Bangladesh. *International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021)*. 11-13 March 2021, BCSIR, Bangladesh
2. Zaman, M.N., Biswas, P.K., Rahman, M.A., and Alam, M.S. 2021. Potentialities of the valuable heavy minerals in the river sands of Bangladesh. *International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021)*. 11-13 March 2021, BCSIR, Bangladesh
3. Biswas, P.K., Alam, M.S., Ahmed, S.S., Zaman, M.N., Pownceby, M.I., Haque, N., Alam, M.S. 2021. Techno-economic evaluation for mineral sands of Bangladesh: A case study for Tista river deposit. *International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021)*. 11-13 March 2021, BCSIR, Bangladesh

4. Biswas, P.K., Alam, M.S., Alam, M.S., Zaman, M.N., Ahmed, S.S. and Rahman, M.A. 2021. Geological characteristics of recent bar sediments of the Tista river as an implication for heavy minerals resources of Bangladesh. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
5. Rahman, M.A., Hossain, M.I.S., Biswas, P.K., Zaman, M.N., Alam, M.S. and Rahman, M.M. 2021. A preliminary study on the sand of Padma river, Bangladesh and its prospect. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
6. Hasan, A.S.M.M., Alam, M.S., Rahman, M.M., Hasan, M.F., Alamin, M. and Hasan, A.B. 2021. Chemistry and mineralogy of biotite mica concentrate sourced from Brahmaputra river deposits, Bangladesh. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
7. Hasan, A.B., Reza, A.H.M.S., Akbor, M.A., Siddique, M.A.B., Zaman, M.N., Biswas, P.K., Nahar, A., Hasan, M. and Alamin, M. 2021. Assessment of metals contamination levels in the soil and water of the ship breaking area of Chattogram, Bangladesh by several pollution evaluation indices. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
8. Sultana, M.S., Biswas, P.K., Zaman, M.N., and Shahariar, M.S. 2021. Physical Upgradation and Characterization of Silicate Minerals of Brahmaputra River Sand for Possible Industrial Uses. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
9. Hasan, M.F., Rahman, M.M., Biswas, P.K. and Zaman, M.N. 2021. Physicochemical characterization of coal from Jamalganj coalfield, northwestern Bangladesh. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
10. Rahman, M.M., Hasan, M.F., Hasan, A.S.M.M.n and Alamin, M. 2021. GIS-Based Morphometric Analysis and Sub-Watershed Delineation to Prioritize the Dharla River Sub-Basins, Bangladesh for Soil and Land Conservation Practices. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
11. Hasan, M.F., Islam, M.M., Farhad, M.I.M. and Khan, M.R 2021. Assessment of Aquifers' Potential for Potable Water Supply in the Proposed Economic Zone in Mirsharai Upazila, Chattogram, Bangladesh. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
12. Sultana, S., Sakib, T.U., Hossain, S.A., and Hossain, M.E. 2021. Suitability Assessment of Treated Sugar Mill Effluent for Irrigation Purposes. International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021). 11-13 March 2021, BCSIR, Bangladesh
13. Tasnim, T., Rana, M.S., Sayem, H.M. and Haque, M.E., 2021. Shrinkage-swelling behaviour of Barind red clay soil of Bogra, Bangladesh (Abstract). International Conference on Science and Technology for Celebrating the Birth Centenary of Bangabandhu (ICSTB-2021), March 2021, Dhaka, Bangladesh, pp 337-338.
14. Mst. Shanjida Sultana, SSO; Raduanul Islam Mridul, Engineer attended and presented articles ICSTB-2021, BCSIR, Bangladesh held on 11-13 March 2021.

PUBLISHED BOOK CHAPTER:

1. Md Khairul Islam, Nawshad Haque, Michael A. Somerville, 2021 “Characterisation and Techno-Economics of a Process to Recover Value from E-waste Materials” The Minerals, Metals & Materials Series, Springer Book Chapter, Link: https://link.springer.com/chapter/10.1007%2F978-3-030-65261-6_88
2. Md Khairul Islam, Michael Somerville, Mark I. Pownceby, James Tardio, Nawshad Haque, Suresh Bhargava, “Experimental Determination of Liquidus Temperature and Phase Equilibria of the CaO–Al₂O₃–SiO₂–Na₂O Slag System Relevant to E-Waste Smelting, Chapter in The Minerals, Metals & Materials Series, Link: https://link.springer.com/chapter/10.1007%2F978-3-030-65489-4_26
3. Shanjida Sultana, Saifuddin Ahsan, Sakib Tanvir, Nawshad Haque, Firoz Alam, Mohan Yellishetty, 2021. “Coal Fly Ash Utilisation and Environmental Impact”, Book Chapter in Clean Coal Technologies, Springer Book Series, DOI:https://doi.org/10.1007/978-3-030-68502-7_15

ACCEPTED PROCESS:

1. Primary ingredients of silica based primer from rice mill boiler ash.- 25.11.2020
2. Preparation of Activated Carbon from Saw Dust - 30.09.2020

SUBMITTED PROCESS:

1. Mst. Shanjida Sultana, Mohammad Nazim Zaman, Pradip kumar Biswas ,Md. Aminur Rahman “Development of artificial granite block using Maddhapara hard rock dust”.

SUBMITTED PATENT:

1. Dr. Mohammad Nazim Zaman, Pradip Kumar Biswas, Md. Aminur Rahman, and Mst. Shanjida Sultana “Recovery of silica sand (quartz) for glass making from Brahmaputra river sand.”

ATTENDED TRAINING COURSE:

1. Md. Imam Sohel Hossain, Participate in a training on ‘Operating and maintenance of Elemental Analyser’ held on 17-21 January 2021 at INARS, BCSIR, Dhaka.
2. Md. Sha Alam, SSO, Advanced Training on ArcGIS10.8 and Envi. 5.6 held from 25/10/2020 to 12/11/2020 at IMMM, BCSIR.
3. Md. Sha Alam SSO, In house Training on “XRD-X-ray Diffractometry” held from 29/11/2020 to 03/12/2020 at IMMM, BCSIR.
4. Md. Sha Alam SSO, Demonstration and General Training on Operation and Maintenance of High Energy Ball Mill held during 22/12/2020 at IMMM, BCSIR.
5. Md. Shohel Rana SO, B&R International Innovation and Development Institute Network (AN-SO-BIDI) School Program from 5th May to 28th July 2021 (online).

FIELD WORK:

Every year scientists carried out their fieldwork and collect bulk sand sample from different river basin to fulfill the R&D activities.



Fieldwork at Brahmaputra river, Chilmari, Kurigram

HIGHER EDUCATION (PhD):

Dr. Pradip Kumar Biswas, PSO has awarded PhD from the Department of Geology and Mining, University of Rajshahi, Bangladesh on 27th February 2021. The research work incorporated in the thesis entitled “Economic Evaluation of mineral sands of the Tista river basin, Bangladesh” under co-supervision of Dr. Mohammad Nazim Zaman, CSO, IMMM, BCSIR.

STUDENTS COMPLETED/PURSUING MS/MSc/BSc THESIS:

Each year our scientists help a number of PhD/MPhil/MS/M.Sc students as co-supervisor for their thesis works. Students receive guidance in the fields of petrology, petrography, geochemistry, materials science, metallurgical engineering, mining, chemistry and other related fields. Within this period (2020-21) there are 8 students who have already been completed their dissertation successfully.

Academic Research Guidance/Supervision:

Sl. N.	Title of the Research	Research Category	Name of the Student	Name of the Academic Institution	Name of the supervisors in BCSIR
1.	Occurrence and distribution of heavy metals in effluent and soil from and around BRB cables industry Kustia Bangladesh with multivariate stastical approach.	MS	Farzana Tanjim	University of Rajshahi	Pradip Kumar Biswas, PSO IMMM, BCSIR Joypurhat

2.	The provenance of paleo-environment and paleoclimatic conditions during deposition of the Neogene sediments in the Sitapahar scture Chittagong-Tripura Foldbelt (CTFB), Bangladesh.	MS	M. M. Saifur Rahman	Jahangirnagar University	Pradip Kumar Biswas, PSO IMMM, BCSIR Joypurhat
3.	Identification of compositional changes of surficial sediments and water due to mining activity of Barapukuria coal mine	B.Sc	Arif Ahmed	Jessore University of Science & Technology	Pradip Kumar Biswas, PSO IMMM, BCSIR Joypurhat
			Umayer Abdullah Zaki		
4.	Petrography and petrophysical analysis of Barail sandstone	B.Sc	Md. Samin Saif	Jessore University of Science & Technology	Pradip Kumar Biswas, PSO IMMM, BCSIR Joypurhat
			Md. Hasibul Hasan Sizan		
5	Microwave assisted extraction of silicon from river sand	MS	Md. Rounokul Islam	University of Rajshahi	Dr. Pradip Kumar Biswas PSO, IMMM BCSIR,
6	Characterization of different biochar produced from different biomass	BSc	Dipto Debnath Hridoy	Jessore University of Science & Technology	Dr. Pradip Kumar Biswas PSO, IMMM BCSIR,
7	Sedimentology of the Oligocene sediments, Bengal Basin, Bangladesh	MSc	Songzukta Mohonta	Jahangirnagar University	Md. Sha Alam SSO, IMMM BCSIR Joypurhat

TRAINING PROGRAM:

In addition to research activities and analytical services, each year the institute arranges several training programs on instrumental methods relevant to Mining, Mineralogy and Metallurgy field. In the fiscal year 2020-21, worldwide Corona Virus pandemic hampered this activity.

SEMINAR ON R&D ACTIVITIES:

Each year the Institute of Mining, Mineralogy and Metallurgy arranges seminars on Research and Development activities on a monthly basis. However, this year, most of the seminar's dates had been postponed because of the worldwide pandemic of Corona Virus except for one date 23 June 2021 with full care of health safety. In the seminars, generally, scientists and engineers present the methodology, progress and achievements of their ongoing R&D projects.



MEETING WITH STAKEHOLDERS/WORKSHOP:

Every year IMMM arranges a meeting with its stakeholders to exchange views of the researchers. Stakeholders including businessmen, entrepreneurs, and journalists discuss and express their views with scientists about the leased out processes and the market demand for national and international aspects. But unfortunately, this year the institute couldn't arrange a meeting with them because of the worldwide pandemic of Corona Virus.

BCSIR SCIENTIFIC AND INDUSTRIAL TECHNOLOGY FAIR:

Every calendar year IMMM arranges a science fair titled 'BCSIR Science and Industry-Technology Fair' involving the students of High schools and Colleges from different districts of the North Bengal region. The participants display their scientific talents in this fair which is funded by the Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh. However, due to the worldwide pandemic of Corona Virus, during this period (July 2020- June 2021) the institute didn't arrange a science fair for health safety. IMMM has also participated in celebrating progress to developing countries held in 27-28 March 2021.



Participation of IMMM in celebrating progress to developing countries.

Photographs of prize ceremony of Science fair-2020 at IMMM

ANALYTICAL SERVICES:

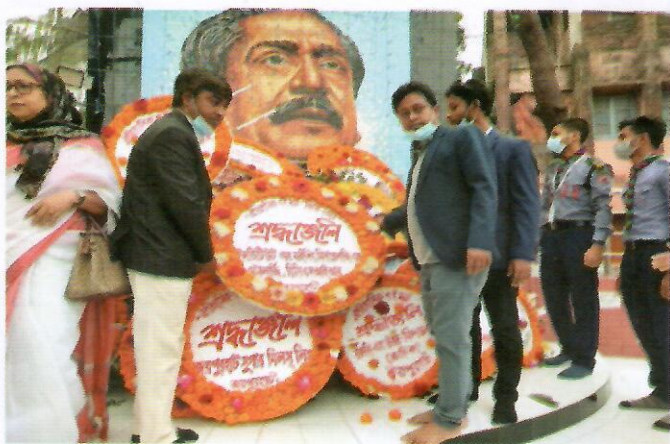
This institute is engaged in the analysis of core samples of the nationally important Padma Multipurpose Bridge project from Foundation Consultation Limited. Mineral separation, mineralogical and geochemical analysis of the samples of Premier Minerals Ltd, Carbon Mining Co. Ltd, Getco Mining, Institute of Water Modeling, Samof exploration and industries like Nasir Glass In., Padma Feed and Chicks, Bengle Ceramics etc. and different government organizations such as GSB, RAB, Customs etc., have been analysed. The analytical service of tensile strength testing of MS rod has done which were given by LGED, Municipality, Upozila Parisod of Joypurhat, Naogaon etc. During the year about 60 analytical services were provided by different divisions of IMMM. We mainly analyze and solve the following problems with their relevant instruments:

1. Compositional analysis of rocks, sand, minerals, ceramics etc. using WD-XRF
2. Phase determination of solids using XRD
3. Analysis of aqueous solutions using AAS & ICP-MS
4. Tensile strength testing of MS rods using UTM
5. Mineral separation using IRMS, EPS, Flotation Cell and Isodynamic separator
6. CHNSO analysis of carbonaceous matter using Elemental Analyzer
7. Determination of Calorific value of carbonaceous matter using bomb calorimeter
8. Particle size analysis using laser diffraction
9. The compressive modulus of rocks using automatic rock testing apparatus
10. Proximate analysis of carbonaceous materials.

ADP PROJECT:

To enhance research activities on heavy minerals of river sand an Annual Development Project (ADP) namely, "Establishment of Mineral Processing Center at IMMM of BCSIR, Joypurhat" under Ministry of Science and Technology approved by ECNEC in duration of 01/01/2017-30/06/2021 has successfully implemented. The newly established Mineral Processing Center (MPC) strengthened the institute as well as provide tremendous research facilities to BCSIR and other several Govt. and Non-Govt. organization. There is a lot of sand mineral processing equipment and analytical equipment installed by this ADP project. The MPC could be turned into a cornerstone of scientific research and contribute a lot for the nation in the field of science and technology especially mineral processing research as well as boost up the country's economy.

MEMORABLE PHOTOGRAPHS:

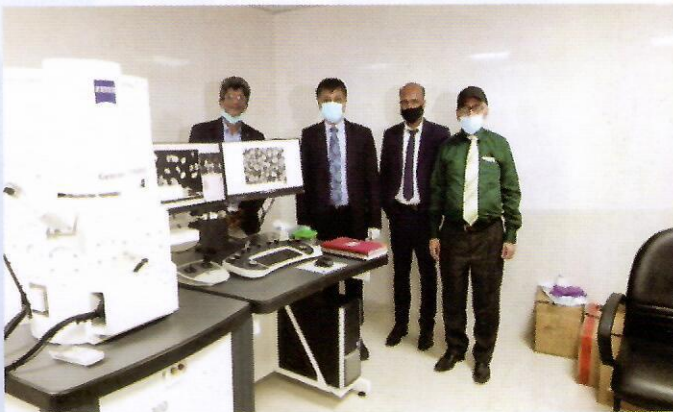




IMMM, BCSIR, Joypurhat celebrated different national days of memories



Honorable Senior Secretary, Ministry of Science and Technology visited MPC, IMMM



Honorable Chairman of BCSIR visited IMMM laboratories.

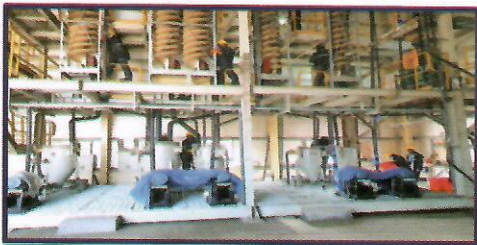


Honorable Chairman of BCSIR visited and planted tree at IMMM



Preparation and distribution of hand sanitizer at IMMM during covid-19 pandemic

INSTRUMENTS USED FOR RESEARCH AND ANALYTICAL SERVICES:



Mineral Separation Plant (Gravity Spiral)

Model: MG6.3, HG10i
Brand: Mineral Technologies
Origin: Australia

Use: Spirals are gravity concentrators used for the separation of heavy minerals like ilmenite, rutile, zircon, garnet, and monazite etc. from light minerals like quartz and feldspar.



Automated Mineral Liberation Analyser includes special software packages with SEM with WDX and EDX/S

Model: Sigma 300 FESEM
Brand: Carl Zeiss Microscopy Ltd.
Origin: UK

Use: To analyze minerals phases, textural studies & image analysis by EDS automation for ore characterization, process optimization and search for metallic and not metallic minerals, industrial minerals, precious metals and rare earths etc



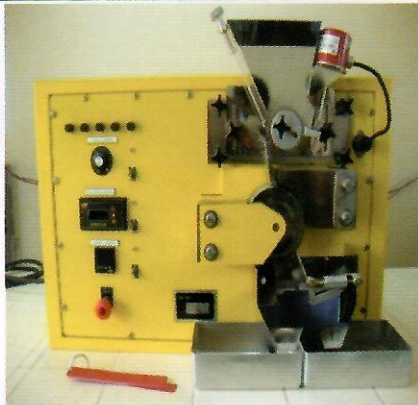
Electrostatic Plate Separator

Model: C162-101

Brand: Carrara

Origin: Australia

Use: The mineral separation from river sand and grinded hard rock of three R&D projects of IMMM has been carried out.



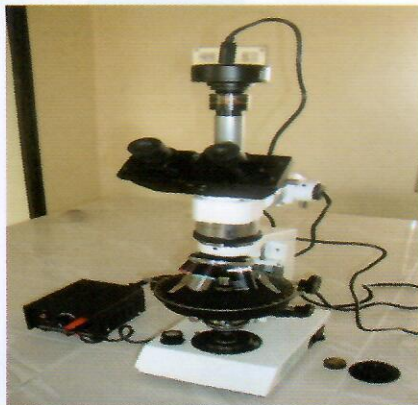
Induced Roll Magnetic Separator

Model: MIH (13)111-5

Brand: Autotec

Origin: USA

Use: The mineral separation from river sand and ground hard rock of three R&D projects of IMMM has been carried out.



Ore/Reflected Microscope

Model: om62a000a

Brand: Microscopes Inc

Origin: USA

Use: Inclusion, exsolution, surface structure etc. of rocks and minerals of the polished block are observed by this microscope.



Thin Section System

Model: 381460256

Brand: Petrothin, Buehler

Origin: USA

Use: Cutting the thin section of rock and minerals for petrological sample analysis is done by this unit.



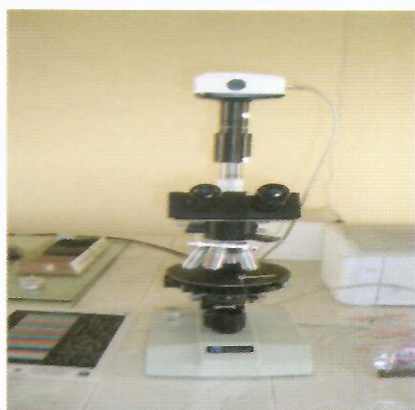
Grinder Polisher

Model: 496050

Brand: Buehler

Origin: USA

Use: The thin section slide of rock and minerals for petrological sample analysis by polarizing microscope is prepared by this unit. The petrological slide for 4 students of Rajshahi University for their academic research has been prepared.



Polarizing Microscope

Model: ML 9300

Brand: MEIJI

Origin: Japan

Use: Mineral identification, grain counting of different R&D projects, academic research for University students has been done.



Binocular Microscope

Model: EMZ-5TR

Brand: MEIJI

Origin: Japan

Use: Mineral grain counting of different R&D projects has been done.



Wavelength Dispersive X-Ray Fluorescence Spectrometer (WDXRF)

Model: Rigaku ZXS Primus

Brand: Rigaku

Origin: Japan

Use: Elemental analysis of different products and raw materials of 13 R&D projects of IMMM and a few R&D projects of BCSIR, research sample of the students of different universities have been carried out by this machine



Controlled Atmosphere Graphite/High Temperature Furnace (30-3000°C)

Model: VHT 8/22-GK
Brand: Nabertherm
Origin: Germany

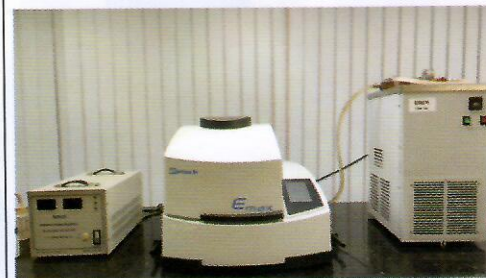
Use: Application includes thermal processes that are carried out under vacuum with non-flammable gases at an over-pressure of approx. 50 mbar. This furnace is used for heat treatment and various metallurgical applications



Simultaneous Thermogravimetric and Differential Thermal Analyzer

Model: STA 8000
Brand: PerkinElmer
Origin: USA

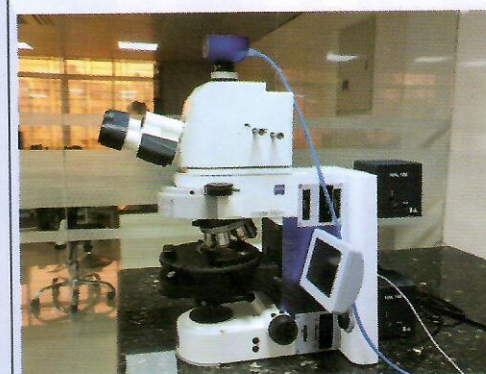
Use: Simultaneous measurement of Thermo-Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC) with simultaneous measurement possibility of TG/ DTA or TG/ DSC.



High Energy Ultrafine Grinding Machine

Model: Emax
Brand: Retsch
Origin: Germany

Use: The Emax is an entirely new ball mill designed for high energy grinding. The maximum speed of 2000 rpm, so far unrivaled in a ball mill, and the innovative jar design produce highly effective size reduction by impact and friction.



Polarizing Microscope with HD Camera and Image Analysis Software

Model: AXIO Imager M2M
Brand: Carl Zeiss
Origin: Germany

Use: The Axio Imager microscopes have been designed as universal microscopes for applications in materials examinations (rocks, minerals, etc). They may also be used as true reflected-light microscopes or, if equipped with transmitted-light equipment, as combined reflect-ed-light /transmitted-light microscopes.

BUDGET ALLOCATION AND EXPENDITURE IN 2020-2021:

Sector Name	Budget Allocation 2020-2021	Total Expenditure 2020-2021	Total Income 2020-2021
Pay and Allowance	1,48,64,029.00	1,47,88,860.00	13,45,424.00
Supply and Services (R&D) and others	1,51,27,620.00	1,43,38,773.00	
Repair and Maintenance	25,65,000.00	24,54,827.00	
Capital Expenditure	9,14,000.00	912,415.00	
Analytical Service Render	-	-	3,34,500.00
Total	3,34,70,649.00	3,24,94,875.00	16,79,924.00

LIST OF THE DIRECTORS WORKED IN IMMM

SL No	Name	Duration	
		From	To
1.	Dr. M. Sanwar Hossain Mondol (Project Director)	07-01-2001	22-09-2005
2.	Dr. Md. Yunus Miah (Project Director)	23-09-2005	31-03-2009
3.	Dr. Md. Yunus Miah (Director -In-charge)	01-04-2009	05-08-2009
4.	Dr. Md. Yunus Miah (Officer-In-charge)	06-08-2009	05-08-2010
5.	Dr. Smarajit Kumar Roy (Director)	06-08-2009	17-10-2010
6.	Mr. Sudhangshu Kumar Roy (Director -In-charge)	18-03-2010	08-03-2011
7.	Mr Sudhangshu Kumar Roy (Director)	09-03-2011	02-07-2011
8.	Mrs. Mahfuza Khatun (Director-In- charge)	03-07-2011	18-10-2011
9.	Md. Shahhidul Islam (Director -In-charge)	19-10-2011	18-04-2012
10.	Dr. Md. Zahurul Haque (Director-In- charge)	19-04-2011	06-06-2012
11.	Dr. Abdus Samad (Director -In-charge)	07-06-2012	19-08-2013
12.	Mr. Md. Moyazem Hossain (Director)	20-08-2013	23-02-2014
13.	Dr. Md. Abdul Hai (Director-In-charge)	24-02-2014	18-05-2014
14.	Dr. Mohammad Nazim Zaman (Director-In-charge)	10-05-2014	Present

MANPOWER

Research Wing:

Sl. No.	Name	Designation
1	Dr. Mohammad Nazim Zaman	Chief Scientific Officer
2	Dr. Md. Abdus Salam (Attached-Chattogram Laboratory)	Senior Principal Engineer
3	Dr. Pradip Kumar Biswas	Principal Scientific Officer
4	Mst. Kamrun Nahar	Principal Scientific Officer
5	Nahid Jahan	Principal Engineer
6	Md. Aminur Rahman (Deputation)	Senior Scientific Officer
7	Sharmin Sultana (Deputation)	Senior Scientific Officer
8	Mst. Shanjida Sultana	Senior Scientific Officer
9	Mohammad Sajjad Hossain	Senior Scientific Officer
10	Md. Sha Alam	Senior Scientific Officer
11	Md. Khairul Islam (Deputation)	Senior Engineer
12	Syed Shafquat Mahmood	Scientific Officer
13	Md. Shohel Rana	Scientific Officer
14	Md. Imam Sohel Hossain	Scientific Officer
15	Kazi Md. Yasin Arafat (Deputation)	Scientific Officer
16	Md. Shams Shahriar	Scientific Officer
17	Md. Kamruzzaman	Technician
18	Md. Helal Uddin	Technician
19	Md. Abdul Alim	Junior Technician
20	Md. Arafat Hossain	Junior Technician
21	Md. Firoz Shah	Junior Technician

Administrative Wing:

Sl. No.	Name	Designation
1	Kamal Chandra Dey	Administrative Officer (In-charge)
2	Md. Faruk Azam	P.A. to Director
3	Md. Hafizur Rahman	Steno-Typist Cum Computer Operator
4	Md. Fazlur Rahman	LDA Cum Computer Operator
5	Md. Shorif Hossain	LDA Cum Computer Operator
6	Md. Imdadul Islam	LDA
7	Md. Rasel Kabir	Library Assistant



Institute of Mining, Mineralogy and Metallurgy (IMMM)

Bangladesh Council of Scientific and Industrial Research (BCSIR)

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