**Project Title**: Nano Processing of Industrial Rejects for Use as Additives in Mix-designs for Improved Pozzolanic Reaction Efficiency in collaboration with Department of Civil Engineering, VNIT Nagpur [S&T, Ministry of Mines, GoI]

**File no**: Met4 - 14/4/2017- Metal IV/Record Cell

**Name of the PI, Institution, contact details:**

**Dr Priyanka Nayar**

Jawaharlal Nehru Aluminium Research Development and Design Centre

pnayar@jnarddc.gov.in : 8411000477: **JNARDDC, Nagpur &**

Dr Mangesh Madhurwar, : mangesh_bits@yahoo.com : **VNIT, Nagpur**

**Objective:**

- To utilize the abundantly available industrial wastes; Aluminium industrial waste (Red Mud, Fly Ash), Steel industry waste (Refractory waste, Granulated Blast Furnace Slag, Plant Sludge) in useful manner by making it nano using either top down or bottom up approach and increasing its surface to volume ratio in order to use it for industrial catalytic and adsorbent activities.
- To process the wastes in such a way so as to enrich any of the three major components and using that enriched residue as precursor to get either individual nano-particles or mixed nano-composites.
- To explore suitable applications of these nano-particles/nano-composites as additives in mix design for better pozzolanic reaction and overall reduced use of binding agent to promote the use of industrial wastes / rejects.

**Abstract:**

Industrial solid wastes in India has led to an increased environmental concern in the recent past. Recycling of such wastes for value addition such as sustainable construction material appears to be viable option to design of green buildings. In view of utilization of various industrial waste for developing sustainable construction material, the current research emphasises on these rejects to cement alternative. These materials were characterized for their pozzolanic behaviour after modified (nanosized) and the materials with improved pozzolanicity were casted into cubes by replacing cement in proportions. Physico-mechanical and durability properties of the cubes made of wastes are investigated and conclusions are drawn. The workability of the blended cement pastes and mortar is greatly modified due to the incorporation of finer Pozzolana materials (lab developed) due to increase in surface area and subsequently enhancement in reactivity. In this project, work have been done to establish maximum consumption of reject materials and its effective & safe utilization in building & construction.

**Finding:**

- JNARDDC selected Granulated Blast Furnace Slag (GBFS), Fly Ash (FA), Lime Sludge (LS), Red Mud (RM) and Sandstone Sludge (SS) for partial replacement of cement and developed process for preparation of building blocks with desired/enhanced physico-mechanical properties. Aluminium industrial waste i.e Red Mud (RM) was collected from alumina refinery NALCO, GBFS from Bhilai Steel Plant, Chhattisgarh whereas, other wastes (Fly Ash, Sandstone Sludge, Lime Sludge) were collected from local industries nearby Nagpur. Two different methodologies (chemical and mechanical) were used to carry out the nano processing of the collected industrial wastes.
- During project investigation, it was observed that selected wastes were not toxic and these wastes after modification in nanomaterials could be secondary resource for building and construction with enhanced physico-mechanical properties i.e. GBFS and fly ash for building applications. The extracted nanoparticles from red mud and lime sludge could be used in other applications such as adsorbents, drug delivery applications etc.


- The industrial rejects which has high percentage of alumina but low silica can be utilized for alkali activated concrete/building blocks with zero cement. This will reduce the GHG emissions as well as the embodied energy of the building products.
- In the next stage, techno-economical process viability at pilot scale with aim for commercial utilization will be explored with industry to achieve the well advocated Make in India program of Govt of India.

- **Publications**

1. ***Preparation of Fe/Ti/Al Nano-particles and Mixed Nano-Composites from Aluminium Industrial Wastes****; Priyanka Nayar, Mohamed Najar, Prajakta Ogale, Shama Wadsariya, Suresh Puttewar, Anupam Agnihotri,* ***Journal of Electronic Design Technology, 9 (2), 24-29 (2018).***
2. ***Pozzolanic Performance Resemblance of Milled Sugarcane Biomass Ash Using Different Pozzolanicity Test Methods;*** *Vasudha Katare, Mangesh Madurwar,* ***Advances in Cement Research, 32 (5), 205-215, 2020.***

3. ***Autogenous Dissolution and Nano-processing of iron in red mud: Green chemistry for value addition and recovery of materials****; Mohamed Najar P A, Amrita Karn, Sneha Dwivedi, Priyanka Nayar, Suresh Puttewar, Anupam Agnihotri,* ***Materials Today: Proceedings, 26 (1), 69-76, 2020.***

4. ***A viable process for recovery and value addition of mineral values: Preparation of calcium nanoparticles from industry rejects****; Priyanka Nayar, Sayali Waghmare, Numanuddin Azad, Paresh Nageshwar, Mohamed Najar, Suresh Puttewar and Anupam Agnihotri,* ***Materials Today: Proceedings, 39 (4), 1722-1726, 2021.***

5. ***Investigation of the effect of mechanical processing of industrial wastes on pozzolanic reaction efficiency;*** *Sandeep Tembhurkar, Priyanka Nayar, Numanuddin Azad, Upendra Singh, Mangesh Madurwar****, Advances in Cement Research (in process).***