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## **Press Release**

### **Turning Waste into Wealth: IIT (ISM) Researchers Develop Eco-Friendly Sand Substitute for Underground Mines**

A research team led by **Prof. Bhanwar Singh Choudhary**, Head of the Department of Mining Engineering at **IIT (ISM) Dhanbad**, in collaboration with experts from **Poland**, has developed an innovative and sustainable solution to one of the mining industry's growing challenges — the shortage of natural sand used in mine backfilling.

As mining and construction activities expand across the world, the demand for natural sand — traditionally used to fill voids in underground mines — has far outpaced supply. At the same time, industries are grappling with environmental hazards posed by **fly ash**, a byproduct of coal combustion, and **plastic waste**, particularly from **high-density polyethylene (HDPE)**.

To tackle both issues, Prof. Choudhary's team explored a creative approach: combining these two waste materials to produce a new synthetic material called **Fly Ash–Plastic Aggregates (FPA)**. This material is made by thermally binding **80% fly ash** with **20% HDPE waste**, effectively converting two major pollutants into a useful resource. “Instead of seeing waste as a burden, our goal was to turn it into a building block for sustainable mining,” said Prof. Choudhary.

The results were remarkable. Laboratory tests showed that the **FPA** particles closely resembled natural sand in texture and strength, while outperforming it in several ways. The aggregates demonstrated **exceptional durability**, high **permeability** (making water drainage easier), and a **low specific gravity**, which simplifies their transport through slurry pipelines in mines.

Using advanced microscopic imaging, researchers observed that **FPA** particles have a **rough, angular surface**, which helps them lock together more firmly — a desirable property for backfill materials. Mechanical testing revealed that the material behaves robustly under pressure, showing **strong resistance to deformation** with a high internal friction angle of **over 40 degrees** — a key indicator of strength in geotechnical engineering.

These findings, achieved in collaboration with **Dr. Krzysztof Skrzypkoeski** (Faculty of Civil Engineering and Resource Management, Mickiewicza, Poland), **Dr. Krzysztof Zagorski** (Faculty of Mechanical Engineering and Robotics, AGH University of Krakow), and **Dr. Anna Zagorska** (Institute of Geological Sciences, Polish Academy of Science, Krakow), mark a significant step toward sustainable mining and waste management practices.

The new **FPA** material could soon replace natural sand and unmodified fly ash in hydraulic stowing — a process where waste materials are pumped underground to fill mined-out areas, ensuring stability and safety.

By developing this dual-purpose technology, the research team not only addresses the **resource crisis** of natural sand but also contributes to **environmental conservation** by reusing industrial and plastic waste.

“This innovation has the potential to transform how we look at industrial byproducts,” Prof. Choudhary added.

“What was once considered waste can now play a key role in sustainable mining and help protect our planet” summed up Prof. Choudhary.

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