

# DEVELOPMENT AND DEMONSTRATION OF HIGH CONCENTRATION FILL TECHNOLOGY ON UTILIZATION OF FLY ASH AS A FILLING MATERIAL FOR UNDERGROUND COAL MINES

A relatively new technology, high concentration backfilling, enables mining industry to think on the use of fly ash as underground back fill material. The advantages are enormous. Jharia and Raniganj coalfields being the oldest in the country had adopted unscientific mining during pre-nationalization period. In many cases mining was conducted without proper stowing and that had resulted in severe problem in these two townships. Both these townships are suffering from severe problems of subsidence. It is anticipated that with the development of this technology it will be possible to solve this intractable problem. The problem of underground fire can also be controlled once this technology is adopted. Due to over exploitation sand for construction industry and non-replenishment of sand in the rivers due to construction of dams at the upstream, sand is gradually becoming a scare material. It is anticipated that it will be extremely difficult to get plenty of sand for stowing purpose in future. So the time is ripe to search for alternate material to replace sand for underground stowing. A survey conducted by CMRI indicates that there are about 25 power plants situated within a distance of 20 Km. of underground coal mines using sand as stowing material at different coalfields of India. These power plants are producing a huge quantity of fly ash which can be used as an alternate stowing material. Ash has several other advantages compared to sand as a stowing material. Once this technology of ash stowing is developed with high concentration form, it will be possible to get a very high rate of stowing which will eventually increase the coal production from depillaring panels.

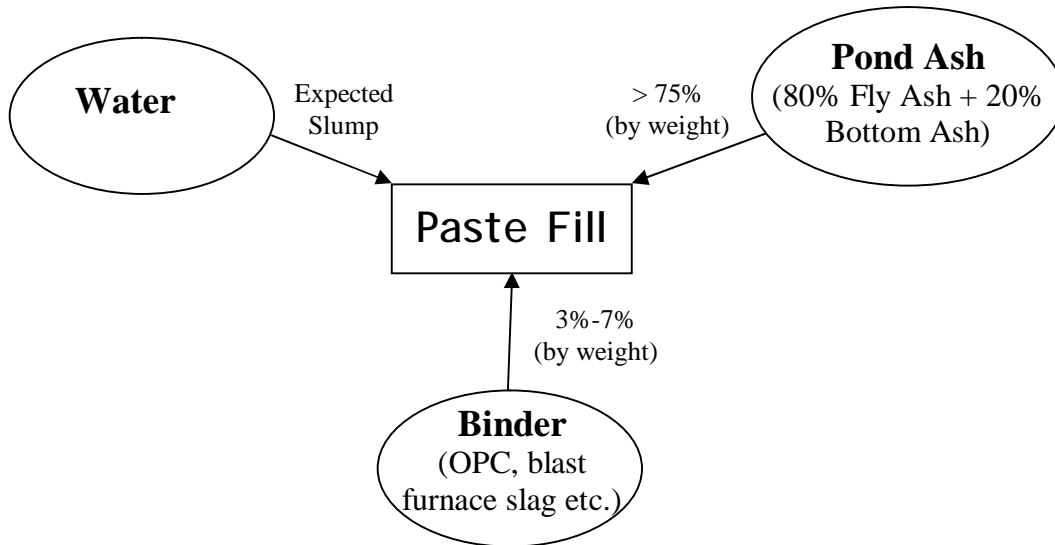
The prevalent mode of void filling is hydraulic sand stowing in which sand water mixture is prepared at surface and is allowed to gravitate to the underground void to be filled. The process of hydraulic sand stowing is inherently slow and is marred with other practical difficulties like non-availability of adequate amount of sand, transportation of sand, additional pumping required to deal with stowing water, jamming of stowing pipes due to quick setting of sand, faster abrasion of pipes by sand, slow stowing rate etc.

The need of the hour is to develop and establish a technology, which could ensure high rate of packing of mine void to meet the higher production requirement. High concentration fly ash slurry disposal system is one such technology. It is proposed to conduct an R&D trial of high concentration fly ash slurry disposal system in one of the underground mines of BCCL with a view to establish the effectiveness of packing the mine void and also to carry out scientific study to find the efficacy of stowed pack.

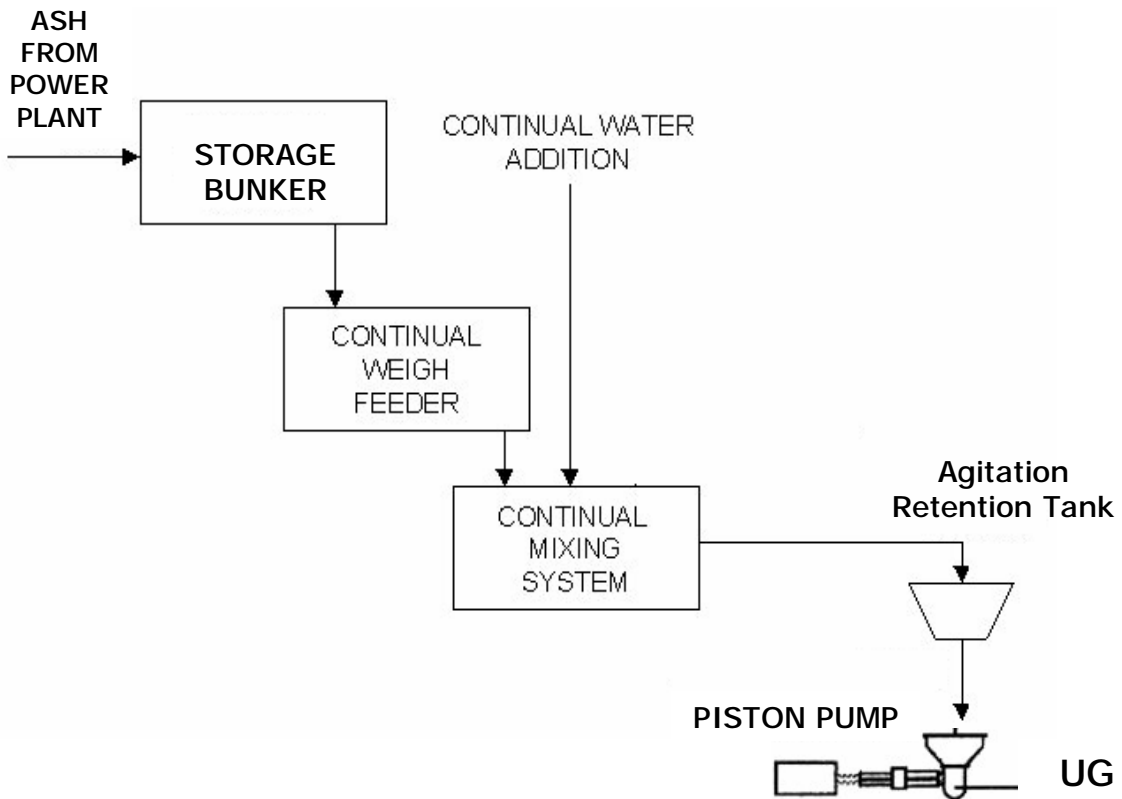
High Concentration Fill Technology mainly involves installation of HIGH CONCENTRATION SLURRY DISPOSAL (HCSD) Plant at the site. This technology basically has two main components:

1. Paste fill preparation at the site
2. Pumping, transportation and deposition of paste fill in underground voids

The different constituent of paste fill is depicted in the figure below:



Different modules of HCSD Plant is shown in the figure below





Paste Flow

Paste backfill of coal ash offer the following advantages over conventional hydraulic backfill systems:

- For paste backfilling mine dewatering cost are reduced significantly as no or minimum dewatering is required and solidification can be achieved due to pozzolanic properties of coal ash and with addition of cementing materials of requisite quantity.
- Generally, all of the coal ash can be used for paste so surface disposal can be remarkably reduced, where as only coarse particles(bottom ash) are suitable for hydraulic backfill. Bottom ash is only 18-20% of the total ash generated and its hydraulic backfilling will not fully contribute to the cause of 100% ash utilization.
- Paste backfill is more dense than its conventional counterpart and has a higher confined strength. This means more of the coal ash can be returned underground, thereby reducing surface ash storage requirements
- The system is capable of handling bulk slurry for stowing resulting higher production.
- The system can be applied in situation where conventional stowing is not feasible due to unfavorable hydraulic gradient.
- Problems on house keeping and wear/corrosion on mine dewatering pumps caused by fines draining from hydraulic backfill operations does not exist with paste backfill
- Shorter fill cycle time can be achieved with paste backfill system because of early strength gain. This can reduce the number of active work face required.
- Low water content of paste backfill eliminates extensive preparatory work for the erection of underground confining drainage barricades.

The principal objective of the scheme is to conduct R&D trial for high concentration fly ash slurry stowing system for packing the underground void with a view to assess:

- ü Feasibility study of pond ash for high concentration filling.
- ü Model study of pond ash for high concentration filling
- ü Field trial of at least 1 lakh cu. m of ash.
- ü The rate of packing with variation in depth of discharge.
- ü Optimum ratio of fly ash : water by volume
- ü Consumption of wearable parts of the piston pump per 1000 m<sup>3</sup> of fly ash stowed.
- ü The direction of flow of slurry once allowed to flow freely at gallery junction through borehole.
- ü Packing efficiency under a specific site condition.
- ü Instrumentation at the stowing range for optimisation of different stowing parameters.
- ü Rock mechanic instrumentation to study the post-fill behaviour of the ash-packed area.
- ü Numerical modelling using Finite Difference Method to study the stability of the stowed and nearby areas.

The success of the project will help in great way in solving the problem of stowing of underground voids in different parts of the Jharia and other Coalfields in India particularly where conventional sand stowing is not feasible due to unfavourable hydraulic gradient. Additionally, the success of this scheme will also solve the age old problem of fly ash disposal of power stations in and around the different coalfields in India. On successful demonstration of this technique the research may be extended for controlling the Jharia fire and stabilization of Jharia and Ranigunj area.

The successful completion of this R&D scheme will result into number of benefits. Some of the benefits are as under:

- ü With the high concentration fly ash slurry stowing system, we may derive some monumental problem of disposal and the challenge of utilization of huge quantity of fly ash which the thermal power stations of the country has to meet the growing demand of power.
- ü Saving of precious land against present method of disposal of fly ash.
- ü The system is highly eco-friendly and will eliminate major environmental pollution due to fly ash.
- ü Reduction in general losses of the power station due to reduction of ash disposal system.
- ü Despite concerted efforts for near complete utilization of fly ash through multifarious ash utilization venture, a short fall would continue between the ash generation and its utilization. Thus, the concept of the system should be viewed as utilization of fly ash.
- ü Very low water consumption compared to conventional sand stowing, eliminating the pumping problem of stowing water.

- ü The slurry meant for packing the void will be very thick and therefore its compaction will be least. This will result into better packing of void which in turn will prevent overlying strata separation more effectively.
- ü Stowing is a major constraint for bulk production as conventional sand stowing is inherently a slow process. The high concentration slurry for stowing scheme is capable of handling bulk slurry for stowing. Therefore, success of this scheme will be bring new dimension to bulk production technology with stowing.
- ü Due to fine particles of ash the wear and tear of stowing pipelines will be much less compared to hydraulic sand stowing.
- ü Reduced quantity of water requirement will reduce the problem created by water like, stopping of production during stowing, bursting of barricades and pipelines etc.
- ü The system can be applied in situation where conventional sand stowing is not possible due to unfavorable hydraulic gradient.
- ü Availability of sand for conventional stowing in JCF is depleting gradually. The system may prove to be an alternative of sand stowing.