CII Environmental Best Practices Award 2020

USE OF MINE TAILING WASTE IN BACKFILLING

Presented by:

- Nilesh Zade
- Sufal Mehrotra
- Rajinder Singh Ahuja
- Pradeep Singh
- Shama Jain

HINDUSTAN ZINC
Zinc & Silver of India

A) Title:

USE OF MINE TAILING WASTE IN BACKFILLING

B) Trigger of the project:

The concept is to find sustainable use of industrial wastes. The project has been successfully validated by R&D team & recognized by Senior Management through internal rewards. Golder Canada a leading organisation engaged for consulting , designing and construction of paste fill plant.

C) Uniqueness of the project: FIRST PASTE FILL PLANT IN INDIA. It's implementation leads to:

- Reducing environmental footprints
- Reduce cycle time and provide mine stability
- Community upliftment (Employment generation)

- **Date of commencement**
  RAM- June 2018
  SKM- Apr 2018
- **Date of completion of project**
  RAM- Feb 2019
  SKM- Aug 2019

*RA booster plant: started: Mar'19 , completed:Sept'19

Milestones	Estimated	Actual
RAM Site work start	Feb-2018	Jun-2018
RAM Plant Commissioning	Dec-2018	Feb-2019
SKM Site Work Start	Mar-2018	Apr-2018
SKM Plant Commissioning	Feb-2019	Aug-2019

Brief on Process

Process Flow

Vacuum Filters being cold commissioned in SK Paste Plant

Types of Mine Backfill

Dry Fill

- Generally consists of surface sand, gravel, open pit waste rock, underground waste rock, smelter slag
- Usually transported underground by dropping down a raise from surface directly into a stope or to a level where it is hauled to a stope with an LHD or trucks.
- Suitable for mechanized cut and fill

Cemented Rock Fill

- Generally consist of classified/unclassified waste rock mixed with a cement slurry to improve the bond strength between the rock fragments.
- CRF contains a mixture of coarse aggregate (<150 mm) and fine aggregate (<10 mm fraction).
- Suitable for long hole open stopping, undercut and fill

Hydraulic Sand Fill

- It can consist either of classified mill tailings or naturally occurring sand deposits mined on surface.
- It is prepared by dewatering the mill tailings stream to a pulp density of approximately 65-70% solids and then passing it through hydro cyclones to remove the "slimes" and retain the sand fraction for backfill.
- The backfill mixture is hydraulically pumped from surface

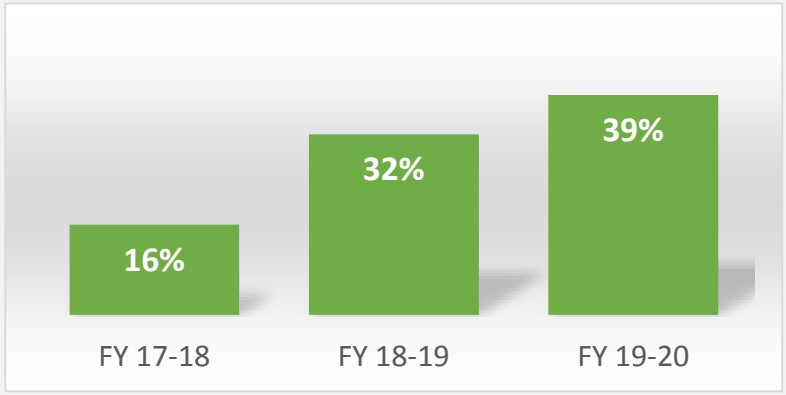
Paste Back Fill

- Paste backfill is a high density backfill (>70% solids depending on SG).
- In order to pump material at this density, a component of fines is required.
- As a general rule, the fines content (<20 micron) should be a minimum of 15% by weight
- The slump of paste backfills is approximately in the 7-10 inch range

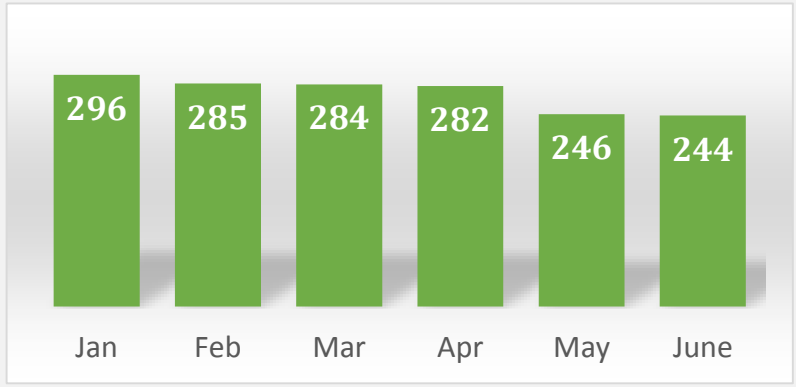
Tangible Benefits

1. Substantial amount of tailings can be used for paste hence reduction in waste disposal to land
2. Because of reduced porosity, paste backfill is more dense than hydraulic sand fill and has a higher confined strength
3. The mining cycle time is less with paste backfill system because strength is achieved quickly (normally 28 days)
4. A paste backfill system facilitates the use of a mechanized undercut-and-fill mining system which increases safety, reduces dilution, and can be used with nearly any orebody shape
5. Flyash (waste from captive power plant) is used in some concentration in place of cement
6. No air emissions, waste generation, water pollution in the process
7. Backfilling of underground voids through paste fill has minimized quantum of mine intersection water
8. Increase in life of waste disposal facility (tailing dam)

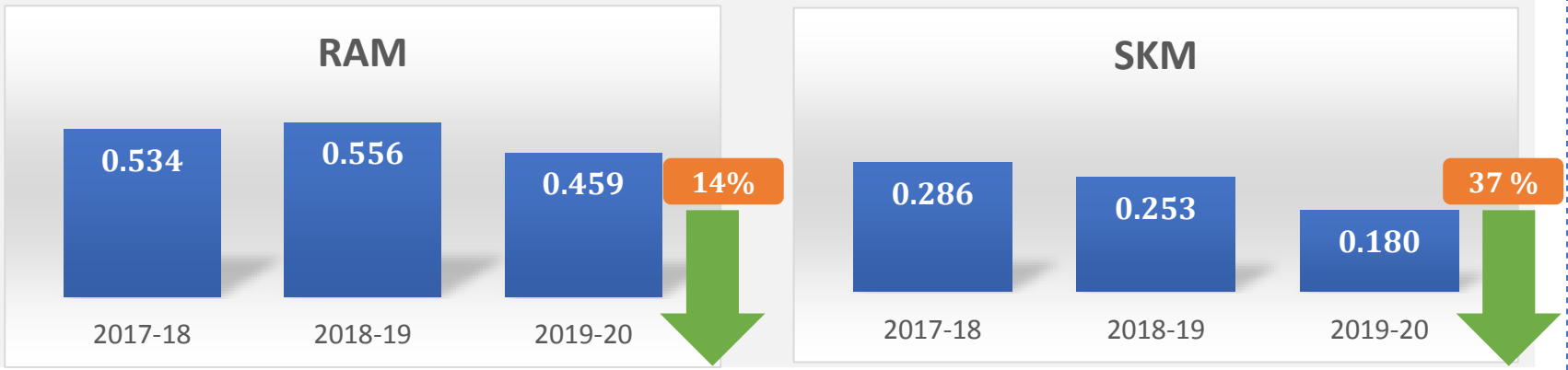
Savings from the Project



Tailing utilization %



Reduction in Use of Cement Kg/M3



Sp. Water Consumption (m3/ MT) reduction

Pay Back Calculation

Rampura Agucha Mine (RAM)	
Profitability	618 Crore
Capital Cost	150 Crore
Payback Months	2.91 Months

Sindesar Khurd Mine (SKM)	
Profitability	936 Crore
Capital Cost	150 Crore
Payback Months	1.92 Months

Last three years utilized 7.4 Million tons of tailings in backfilling and avoided land disposal

Intangible Benefits

1. The project helps in significantly reducing environmental contamination and pollution by minimizing waste dumping through tailing utilization and fly ash consumption. The process has no air emissions and recycled water is used.
2. Implementation of the project generates employment opportunities which benefits the people/society and community upliftment
3. The project aligns with Vedanta's and HZL's policy of **"Zero Harm, Zero Waste, Zero Discharge".**

Alignment with Sustainability Goals 2030

Replication potential, Progress & Spreading benefits of the Project

Basic idea – Utilization of tailing in mine backfilling in form of paste

Replication potential – Mining industries with large ore to void ratios.

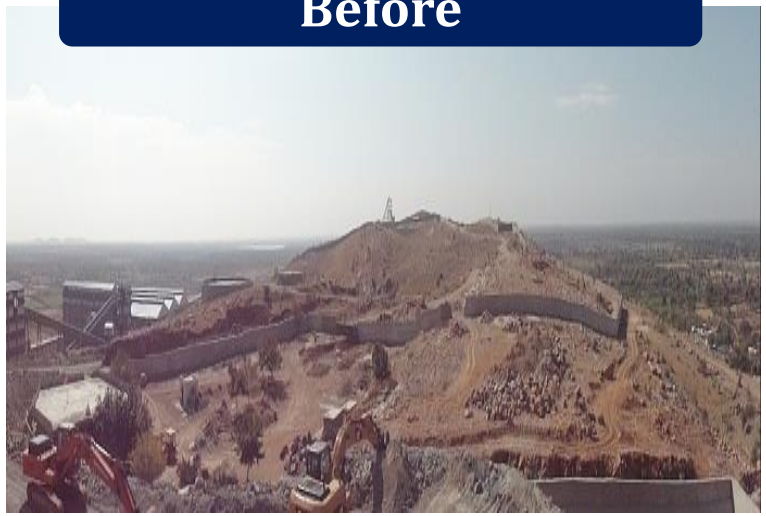
Implementation at HZL –

- Paste fill plant with capacity of 6 MTPA & 5 MTPA has been set up at SK and Agucha respectively
- A new paste fill plant has been commissioned at Zawar Mines with capacity of 1 MTPA

Spreading Benefits

- Stability of Mine
- Increase in production cycle
- Safety of mine & Tailing Dam
- Increase in water recovery
- Maximum use of tails in backfilling thus less tailing discharge in tailing dam
- Use of fly ash as binder in place of cement

Before



After

Replication potential of project within sector

International Paper

- **A comparison of two paste plants in Ind**ia- Australian Centre for Geomechanics
- **Design of Booster Stations for Paste Backfill and the Implementation at Hindustan Zinc's Rampura Agucha Mine-** PASTE 2020 – 23rd International conference on Paste, thickened and filtered Tailings
- **Innovations in Paste fill Technology-** Underground operators 2021 Conference
- **Hindustan Zinc making numerous future mining strides-** IM International Mining

Visits for learnings

- **Statutory authorities/ Policy Makers**
- **Other Industry**

Social Media

Case Studies published in Various public domain platform

- **HZL Annual Report/ Sustainability Report**
- **Vedanta Annual/ Sustainability Report**
- **HZL Website**
- **Social media – Twitter/ Facebook / LinkedIn**

Hindustan Zinc's Sindesar Khurd Mine received the "Bala Gulshan Tandon Excellence Award – 2018", for "Best Overall Performance in Sustainable Development" from FIMI (Federation of Indian Mineral Industries).

Challenges faced and brief on countering

Problem Statement	Root Cause	Solution
Inability to backfill stopes at large distances(>1.5kms) through gravity line	• Long horizontal pipelines in underground minimizing effect of gravitational force	• Installation of PD(Positive Displacement) pumps to backfill stopes with high pressure
Low Utilization of Paste fill plant	• Non-availability of stopes for backfilling • Time taken for stope change	• Backfilling plan for the next 3 months ensuring multiple stope availability for both plants • Installing diverter valves at surface and underground lines for quick stopes changeover to increase availability and utilization
Raw Material Availability and Utilization(Tailings)	• Dependency of paste fill plant on mills and inability to store large volumes tailings	• Synchronized Operation Plan for Mill and Paste fill for maximum tailing utilization
Reduction of Operational Break Downs	• Filter Feed nozzles jam • Mixer breakdown due to gearbox	• Filter Feed Line replacement by Trellex Pipe and trash Screen Modification. • Installation of greasing system in Mixer
High Operational Cost	• 80% operational cost due to cement usage in binder concentrate	• Optimizing cement usage in binder concentrate by Flyash addition

Achieving National Benchmarks/Standards

Hindustan Zinc is the first mining company in India to setup Paste Fill plants with a total capacity of 12 MTPA.

1. The project aligns with Vedanta's vision of continuous implementation of latest technology in industry which improves process efficiency and reduces Environmental contamination.

2. The paste fill plant
   @ SK Mines has a design capacity of 6 MTPA it is being operated at 7 MTPA
   @ RA Mines has a design capacity of 5 MTPA it is being operated at 6.4 MTPA

3. Fly ash usage in binder concentrate was successfully achieved in collaboration with CRDL(Central Research & Development Laboratory) and approved by DGMS(Govt of India)

4. PD Pump at SKM is one of biggest Positive Displacement pump across the world with 110 Bar pressure & flow 240 m3/hr

5. Booster plant at RAM is one of the biggest booster pumping station across the World

Priority plans on fast track for +1 year and +2 years

+1 year Plans

- Ramping up the total Backfilling hours in all Paste fill units of HZL to reduce ore void ratio and increase safety.
- 55% tailings Utilization to comply with “Zero Waste, Zero Discharge” policy of HZL.
- Maximize Fly ash (Waste produced in power plants) in Paste Concentrate and optimize cement consumption to reduce waste dumping & to reduce cost of production

+2 years Plans

- R&D has started projects for utilization of other industrial wastes that can be used for Backfilling Process.
- To reduce cement consumption by 50% by using other alternate binder material
- 2 MTPA Paste Fill Plant at RD mine

Top Ten Best Practices

1. Paste production with optimal strength increasing mine safety and reducing cycle time
2. Advance use of digitalization in underground mines
3. Using other alternate binder material such as Fly ash to reduce the cement consumption
4. Use of high end pressure transmitters, CCTV cameras, lifting machineries
5. Increase use of recycle water

6. Online Monitoring & Leaky Feeder Communication
7. Use of high pressure & robust diverter valves
8. Improvement in power consumption by using automation techniques
9. Inhouse training center
10. Robust emergency preparedness plan

Major Learnings from the Project Implementation

01 Implementations of modern technologies which can run the business more efficiently without causing any harm to the environment .

02 Efficiency and Reliability of Paste Fill over other Backfilling process like sand fill and hydraulic fill.

03 Reducing Environmental Footprint (increased gainful utilization of waste, increased water recycling) through change in technology

THANK YOU