**Underground Mining of Metalliferous Deposits**
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**Lecture 45**
**Backfill Materials**

## BACK FILL MATERIALS

**Mine backfill** is soil, overburden, **mine** tailings or imported sand, aggregate material used to replace excavated zones created by **mining** operations.

Rock fill can be cemented or non-cemented **mine** waste rock or aggregate material placed underground by means of:

- Trucks, conveyors, raises
- Boreholes
- Combination of borehole and pipelines
- Previously hydraulic back filling of stopes was carried out by means of **river sand** using timber barricades lined with bamboo mats.
- Establishment of **milling facilities** at the pit head and availability of **mill tailings** completely revolutionized the filling system using back fill.

**Purpose of backfilling:**

- The backfill material provides support to the surrounding rock mass, reduces wasteful dilution, enables a safe working area for production activities and mitigates the risk of surface subsidence.
- By combining tailing materials in backfill, it is possible to reduce the environmental footprint of the mine and assist with final site rehabilitation.

**Types of mine back fill:**

- Rock back filling
- Hydraulic back filling/stowing
- Paste back filling (Cemented)
- Hydraulic stowing is the most popular method of backfilling underground mines.

**Essential Properties of fill materials:**

1) **Percolation rate:** This depends mainly on shape, size and size distribution of particles. The recovery of tailing sand varies from ore to ore. Finer the grinding in the mill, more is the fines which is to be rejected as slimes. In case of lower percolation rate it would be advisable to allow longer time for drainage of water.

2) **Settling rate :** Most classified mill failings having an average size of about 50% settle pretty fast. However with increasing percentage of slime ( which is sometimes due to increased the sand recovery) settling takes longer time.

3) **Supporting ability :** Settled tailing fill undergoes least amount of compression.

Tailings coming out of the mill have a wide range of size distribution.

| **Mesh size** | **+45** | **+100** | **+200** | **+325** | **-325** |
|---|---|---|---|---|---|
| **% fraction** | 0.6 | 22.6 | 34.6 | 18.7 | 23.5 |

Tailings coming out of the mill also have variety of shapes.

| Mesh size/ shape | +45 | - 45 to +100 | -100 to +120 | -120 to +200 |
|---|---|---|---|---|
| Cuboidal | 11 | 12 | 21 | 24 |
| Tubular | 17 | 36 | 29 | 18 |
| Platy | 69 | 45 | 34 | 39 |
| Triangular | 1 | 6 | 11 | 16 |
| Cylindrical | 2 | 0 | 5 | 3 |

**Volumetric relationships**

Lumping the solids, liquids and the gas(air) in the tailings mixture:

$V = Vs + Vw + Va$

Where,

V = Total volume of tailings

Vs = Sum of the volume of all solid grains

Vw = Sum of the volume of all water contained between the grains

Va = Sum of the volume of all the air between the grains and water film

VOID VOLUME = Vv = Vw + Va

*Void Ratio* $e = \frac{V_v}{V} \frac{V_v}{V}$

*Porosity n is defined as*

$n = \frac{V_v}{V} \frac{V_v}{V}$

*Where,*

$V_v$ = *Void volume*= $V_w + V_a$

$V_s$ = *Sum of the volume of all solid grains, and*

*V = Total volume of fill*

**Processing of tailing for filling (Fill processing)**

- The total tailing obtained from the concentrating plant, needs o be processed before it is used as fill material.
- We must maintain a suitable relation between the fill quantity and quality, the one in general varying inversely with the other.

**Fill processing: De-sliming**

**Coarse** + Fine slimes

The process is known as "De- sliming" and is done by means of **hydro cyclones.** With single stage hydro cyclone about 60% by weight of the ore milled is recovered as fill material, which is the underflow fraction of the hydro cyclone. Underflow of the hydro- cyclones has a pulp density of 70% solids by weight. After **proper mixing with water**, it is taken down the mine by gravity action with a solid concentration of 60% by weight.