ARC INNOVATIONS

BACKFILL BINDER SYSTEM

Backfill Binder System

System -

The backfilling provides ground support and regional stability, thus facilitating ore removal from nearby regions. The large underground voids created by the ore removal are backfilled with the waste tailings in the form of paste fills, hydraulic fills, and others. The tailings are placed in the form of slurry that undergoes self-weight consolidation. A small dosage of binder is added to paste fill and cemented hydraulic fill to enhance strength. Considering the high cement cost, mines are using fly ash and slag to partially replace cement with blended cements.

There are several key parameters that must be evaluated to understand which type of fill can be applied on a mine.

- Enabling a more complete extraction of the ore body
- Environmental constraints
- Management of surface subsidence
- Minimising waste-rock dilution
- Promotion of mine stability
- Reducing the volume of waste hauled to surface
- Recovery of remnant ore pillars
- Surface disposal limitations

Several types of backfill can be applied :

Rock Fill

- Placement of waste rock into the mining void. Generally undertaken using trucks and gravity, but sometimes placed or pushed up using LHDs
- Development or run-of-mine waste (sometimes imported waste)
- Load Haul Dump (LHD) loaders, haul truck or conveyor
- Suitable as a working platform or for secondary stopes. Cannot be exposed vertically or under-cut
- Little quality control, highly variable particle size
- Relative cost: Low

Cemented Rock Fill

- Cementitious slurry applied to waste rock. Systems vary but slurry is added to the waste rock, is mixed, and then placed into the stope using a truck or LHD
- Ideally crushed and screened rock, development, or run-of-mine waste (sometimes imported waste). Particle size optimisation required to maximise particle-packing density
- LHD or haul truck. Cementitious slurry via agitator truck or slickline from surface
- Possible to achieve strengths >4 MPa depending on mix. Vertical exposure
- Size manipulation, mixing systems and deposition method greatly affects the final product quality
- Relative cost: Low to High. Trade-off between capital and operating costs
- Excellent for: Filling voids which will be exposed during future mining

Hydraulic fill

- Hydraulic disposal of tails into stope, with or without Solids will settle and require topping up to full on several occasions. Fill fence or weep-bags designed to allow water to escape
- Coarser than paste fill. Often requires hydro-cyclone (or similar) to modify Particle Size Distribution (PSD)
- Reticulated from surface. Contained behind fill fence or in weep-bags
- The backfill dewaters during placement so increases demand on mine dewatering system. Requires topping up as backfill dewaters. Water cannot be allowed to accumulate in the stope as this poses a risk of failure or inundation to the mining operation
- Good quality control possible, susceptible to binder segregation during dewatering
- Relative cost: Low cost for a hydraulically delivered product but cement cost is high when
  required
- Excellent for: Establishing working platforms and vertical exposure where mine water is not considered a problem

Paste fill/ Cemented aggregate fill

- Binder added to whole-stream tailings, with or without aggregate and reticulated into the mine void
- Minimum 15% passing 20 Mm
- Reticulated from surface. Contained behind fill fence or weep-bag
- High quality control, homogenous product
- Relative cost: Capital cost generally higher but operating costs lower than for hydraulic fill. Costs must be traded off vs backfill quality
- Excellent for: Stabilising voids and backfilling workings and filling voids which will be exposed during future mining exposures

Advantages of using Ec0star are:

- Conventional backfill binders bleed at a rate between 29 to 36%. Ec0star is currently at 18% to 22%. Based on the 18% to 22% bleed, that is approximately 15% more gained backfill volume underground.
- Efficiency % per ton of backfill placed is currently 80%.
- Phase 2 of the product will have a 100% efficiency of backfill placed
- 100% locally manufactured product.
- Flow rate is approximately 6.9 seconds.

BACKFILL BINDER SYSTEM - EC0STAR

ECOSTAR IS PUMPED UNDERGROUND FROM SILO

ECOSTAR IS BINDED WITH TAILINGS TO PRODUCE BACKFILL

BACKFILL IS PUMPED INTO SUPPORT PACKS TO FILL CAVATIES

UNDERGROUND MINING AREA

Ec0star (see MSDS and TDS)

Need a TDS

Ec0star complies with the 32.5 specification when tested as per SANS 50197.

Ec0star achieved strengths of approximately 5.7MPa for 28 days by using 8% of binder with a tailings of 25% passing 25 micron.

Arc Innovations has a delivery capacity of 8-10 trucks per day. Each truck has a capacity of up to 32 tons meaning that Arc Innovations can deliver around 250 – 320 tons per day.

Conventional backfill binders bleed at a rate between 29 to 36%. Ec0star is currently at 18% to 22%. Based on the 18% to 22% bleed, that is approximately 15% more gained backfill volume underground.

The efficiency % per ton of Backfill placed is currently 80%. Arc Innovations have already started to look at ways to make improvements on the product. The phase 2 product that is currently being finalised will have a 0% bleed that is required to attain tight-fill and reduce the amount of water seeping through the rock or into excavations. This has also been tested and verified at external laboratories.

The higher bleed of backfill placed results in more water accumulating underground. This means that larger volumes of water will require pumping resulting in higher maintenance on pumps. Bleed water running through fissures cause disruption to other underground works thus lowering the production rate of the mine. The movement of the material through fissures also require additional amounts of backfill to be placed. This was one of the crucial aspects that Arc Innovations experienced underground.

Mining Charter Compliance

There are many advantages of purchasing Ec0star in terms of the Mining Charter Compliance as Ec0star is a 100% locally manufactured product and Arc Innovations are a level two B-BBEE compliant company with 65% black ownership.

Flow Rate

The flow rate of Ec0star is approximately 6.9 seconds.

Benefits Of Using Ec0Star

- Strengths of 5.7MPa achieved for 28 days using 8% binder.
- Product complies with 32.5 specification when tested as per SANS 50197.
- Efficiency % per ton of backfill placed is currently 80%.
- A 100% efficiency of backfill placed can be achieved in the phase 2 of the product.
- Currently 15% more gained backfill volume underground compared to conventional backfill binders.
- Ec0star is a 100% locally manufactured product.
- The flow rate is approximately 6.9 seconds.

1. Company Details

Name: ARC Innovations (PTY)LTD
Address: 82 Bonnyvale road, Norton Home Estates
Benoni, 1501
In case of an emergency contact either Cyril Attwell (0784563833) or Umar Kadwa (0844560011)

2. Composition

Product name : Ec0star
CAS no : CAS # 12168-85-3
CAS # 10034-77-2
CAS # 12042-78-3
CAS # 12068-35-8
CAS # 13397-24-5
CAS # 1305-78-8

3. Hazardous Identification

Hazard Classification – Irritant

(ii) Hazard ID - Rating
(a) Health Rating : 1 - Slight
(b) Flammability : 0 - None
(c) Instability : 2 - Moderate
(d) Contact Rating : 2 - Moderate

(iii) Personal Protective Equipment: Wear gloves and long sleeves

(iv) Overview: Ec0star dust acts as a skin and respiratory irritant. Dust and wet Ec0star act as a serious eye irritant. Long term exposure may lead to contact dermatitis.

4. First Aid Measures

First Aid Inhaled : Remove exposed person to fresh air. Prolonged exposure at high dust concentrations may cause a cough and phlegm.

First Aid Skin : Wash with water and soap.

First Aid Eyes : Wash eyes with large volumes of water. Seek medical attention.
The fornices (behind the eyelids) should always be checked for congealed material.

First Aid Ingested : Ingestion in a harmful quantity is very unlikely to occur.
If ingested drink plenty of water and consult a doctor immediately.
DO NOT INDUCE VOMITING.

5. Fire Fighting Measures

This product is not combustible, use agent most appropriate to extinguish surrounding fire.

6. Accidental Release Measures

Personal precautions : Dust mask where TLV is exceeded. Wear eye shielding. Any type of glove which prevents contact with the product
Environmental precautions : Non toxic in small quantities. Large quantities in water will lead to high pH values, up to 12.5. Aquatic life will be endangered.

The Ec0star will harden, possibly forming a crust. It may dissolve slowly in acid conditions

(1) Small spills
(a) Containment Sweep up. Prevent dust becoming airborne
(b) Clean-up Sweep up. Prevent dust becoming airborne

(2) Large spills
(a) Containment Sweep up. Prevent dust becoming airborne (b) Clean-up Sweep up. Prevent dust becoming airborne

7. Handling and storage

During handling aerated Ec0star has liquid properties which disperse after settlement.

Storage Colour Code : Orange
Suitable Material : Paper or plastic bags. Silos, bin.

8. Exposure Controls/Personal Protection

Occupational exposure limits : TWA OEL RL 5mg/m3 respirable dust, 10mg/m3 total inhalable dust.
Personal protection : Dust mask, safety glasses or goggles, gloves 9. Physical & Chemical Properties
Physical Properties :
Fine grey to white powder. Particle size < 0.1 mm. Relative density 2.2 to 3.8 g/ml Melting point > 1500°C
Alkalinity can exceed pH of 12 in water.
Chemical Properties :
No hazardous decomposition products

10. Stability and Reactivity

Stable, but product will solidify over a period of hours if moistened or wet. Absorbs moisture from the air and solidifies over prolonged periods if not kept in a protected dry atmosphere.

11. Toxicological Information

Dust acts as a skin and respiratory irritant. Dust and wet Ec0star cause serious eye irritation. Long term exposure may lead to contact dermatitis

12. Ecological Information

Non toxic in small quantities. Large quantities in water will lead to high pH values, up to12.5. Aquatic life will be endangered. The Ec0star will harden, possibly forming a crust. It may dissolve slowly in acid conditions.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. Dispose of container and unused contents in accordance with local regulations.

14. Transport Information

In terms of the National Road Traffic Act, act 93 of 1996 regulations and SANS 10228 (The identification and classification of dangerous goods for transport by road and rail modes), Ec0star and Ec0star blends are not hazardous.

In terms of the International Maritime Dangerous Goods Code, Ec0star and Ec0star blends are not hazardous and as such do not have a U.N. number. Ec0star is listed as an Appendix C cargo in terms of the BC code.

15. Regulatory Information

Not regulated

16. Other Information

Risk phrases R36 R37, R38
Safety phrases S24, S25, S26, S36, S37, S39 · R36 Irritating to eyes.
· R37 Irritating to respiratory system.
· R38 Irritating to skin.·
· S24 Avoid contact with skin.
· S25 Avoid contact with eyes.
· S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
· S36 Wear suitable protective clothing.
· S37 Wear suitable gloves.
· S39 Wear eye/face protection.

Description

Ec0Star is a propriety blended cementitious material designed to be blended with mine tailings to achieve stable backfill.

Typical Uses :

Ec0Star is a typically used in backfill operations to achieve a stable backfill product in a weep or non-weep system.

Further benefits are:

- Ability to set and strengthen in low waterflow.
- Low bleeding.
- Good flowability and pumpability for long durations.
- Low pump pressures.
- Low carbon footprint.
- Increase production achievable with the same labour force and equipment.

Special Features :

Ec0Star increases fluidity and lubrication in underground pipeline systems.

Limitations :

Ec0Star should not be used in an unventilated environment.

Physical Properties :

pH	12.0
Specific Gravity	2750-2900kg/m³
Colour	GREY

Please read MSDS in conjunction with the TDS.

Packaging :

30kgs Bags or bulk tanker

Storage :

Keep in bulk silos or cool containers off the ground.

Shelf Life :

6 months if correctly stored.

Technical Advice

The technical department is available to assist with advice on the correct application of the Ec0Star.

Advantages of using Ec0fill are:

- Higher compressive and flexural strengths
- Better flow rate
- More economical
- Superior chemical resistance
- Lowers hydration tempratures
- Reduction of pump-line pressures
- Quicker mixing per batch
- Reduced production times
- Removal of toxic pollutants
- Removal of chemical burns within cementitious systems
- This system requires any type of cement based on strength requirements mixed with ecofill to give the desired results.

BACKFILL BINDER SYSTEM - EC0FILL

ECOFILL IS PUMPED INTO THE MIXING TANK ABOVE THE GROUND

MIXING AREA

UNDERGROUND MINING AREA

BACKFILL IS PUMPED INTO SUPPORT PACKS TO FILL CAVATIES UNDERGROUND

Ec0fill

Contractors at a site that is using Ec0fill as a backfill grout binder have reported the following benefits of using Ec0fill compared to fly ash:

- The placing of the blasting materials can take place simultaneously while grouting without the presence of Ammonia
- The ammonia smell above ground at the grout mixing plant has being removed.
- A reduction of the caustic nature by a factor of 200 times of the support grout has meant that there are no chemical burns.
- A reduction of carbon footprint from ±280 kgs.CO_2/m^3 to ±100 kgs.CO_2/m^3
- A reduction of carbon footprint equivalent of 1440t of CO_2 per month
- A shortening of mixing time of approximately 10 seconds (15%).
- Pumping of a higher density material means that support packs can be completed 40% faster.
- An overall increase of production estimated at 20 to 30%.
- Blasts have occurred at 45 minutes after completion of the pack without requiring the pack to be re-pumped.
- A reduction of pipeline pressures of 20 – 25%
- A significant reduction of plant downtime.

ARC INNOVATIONS

CONTACT DETAILS

CONTACT NUMBER(S)

Cyril Attwell (0784563833) / Hassim Osman (0827864003)

ADDRESS

82 Bonnyvale road, Norton Home Estates Benoni, 1501

WEBSITE

https://www.arcinnovations.co.za