# Latest Technologies and Systems

# for

# Handling and Utilization of waste

***to conserve resources.....***

# Conserve Resources

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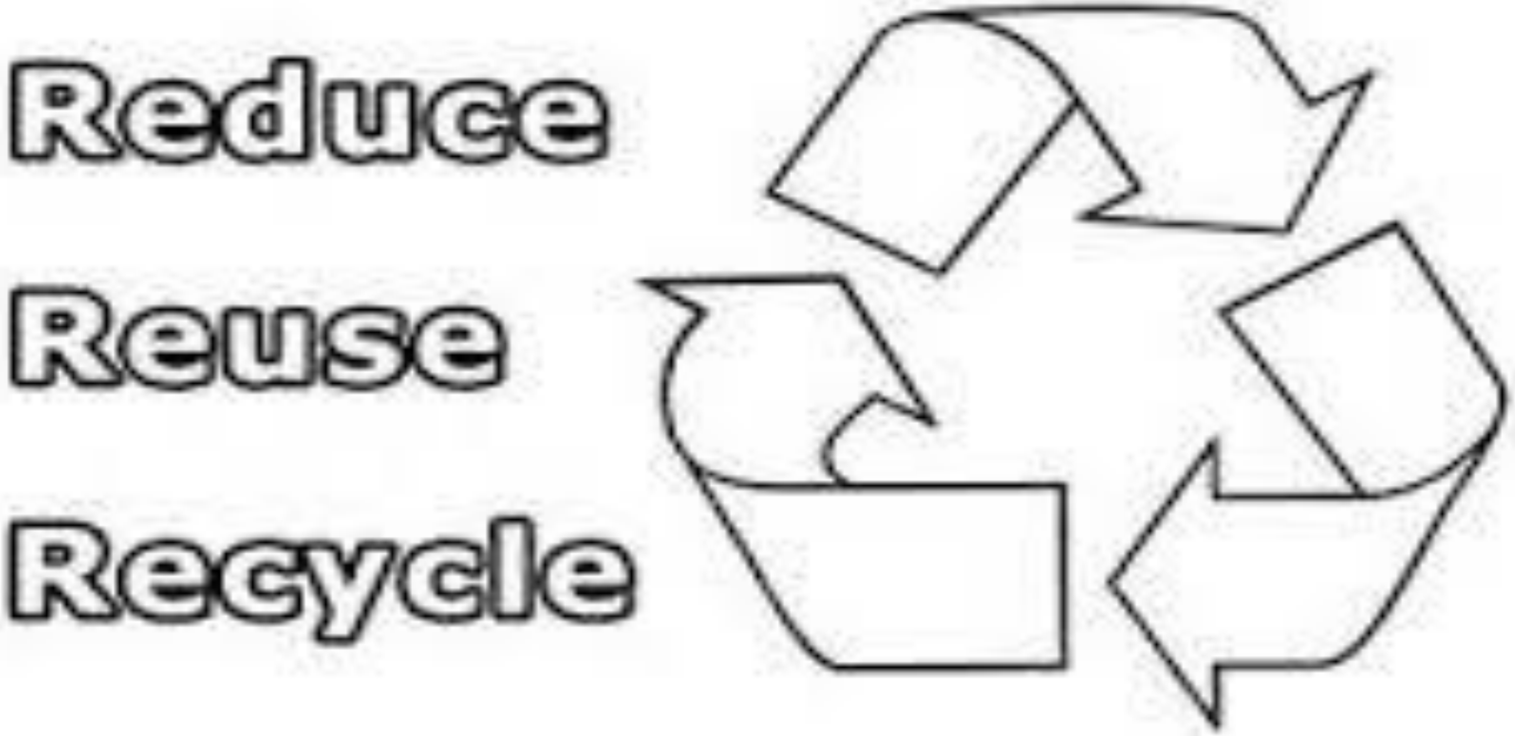

# Conserve Resources

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INNOVATIVE TECHNOLOGIES

***"Triboelectrostatic Separators for Mineral and Fly Ash industries"***

# Innovative Technologies
*Conserve Resources*

## ***Flyash Beneficiation***

Dry Separation of Unburnt Carbon to enhance Flyash quality

## ***Limestone Beneficiation***

Dry Separation of Silica / Quartz to enhance Limestone quality

# Beneficiation Process

*Benefits*

## Sustainability Benefits

- Small physical footprint
- Dry Process
- Low Energy 1-2 kWh/ton
- Environmentally Friendly
  - No water / no wastewater
  - little or no chemicals
  - Easy to permit – single dust collector
- Resource Optimization
  - Converts waste into Valuable Products

## Further Benefits

- High rate: up to 40-50 TPH
  200,000 T/yr per Separator
- Separates particles <1µm to ~500µm
- Ease of Operation
  - Rapid start-up and shut-down
  - Rapid response to feed variability
  - Amenable to automation
  - Limited qualification of operators required
  - Produce several grades of product easily

# Beneficiation Process
*Commercial Application*

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**Proven Outcomes / Successful Installation**

| | Calcium Carbonate | Talc | Barite |
|---|---|---|---|
| Feed | ▪ 9.5% $SiO_2$ | ▪ 58% Talc<br>▪ 42% Magnesite | ▪ 200,000 TPY<br>▪ 82%BaSO4<br>▪ 3.78 (SG) |
| Results | ▪ < 1% $SiO_2$<br>▪ 89% $CaCO_3$ Recovery<br>▪ Improved Brightness | ▪ 95% Talc<br>▪ 77% Recovery<br>▪ 88% Talc<br>▪ 82% Recovery | ▪ 92% BaSO4<br>▪ 4.21 SG<br>▪ 74% Recovery |

**Canada**
**2 units**

**India***
**1 unit**

**Ausrtia**
**1 unit**

**United State**
**1 unit**

# Beneficiation Process

*Outline - Flyash Beneficiation*

- **Aspect**

  **Separation of Unburnt Carbon** from flyash

- **Impact**

  Separated **Carbon for fuel value**

  Improved usage of **processed ash in Cement and other application**

- **Sustainable Control**

  Usage of **innovative technologies** to enhance the absorption of solid waste in Cement application.

# Beneficiation Process

*Outline – Limestone Beneficiation*

- **Aspect**

  **Reduction of Silica** from limestone

- **Impact**

  Improved usage of **highgrade limestone** in Cement rawmix & other application

  **Replacement of imported highgrade limestone & reduction of additives**

- **Sustainable Control**

  Usage of **innovative technologies** to enhance the absorption of solid waste in Cement application.

# Beneficiation Process

*Operating Principle*

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- **Triboelectrostatic Separators** for Dry Separation of Unburnt Carbon to enhance Flyash quality / of Quartz to enhance Limestone quality

- **Differential charging** between materials, produced by surface contact known as **triboelectric charging,**

- Material with **highest affinity** for electron becomes **Negatively charged,** while other becomes positively charged.

- **Counter current flow** of separating particles and **continual triboelectric charging** by Carbon-Mineral collisions provides for **multi stage separation** and results in **excellent purity and recovery** in a single pass unit.

# Beneficiation Process

*Operating Steps - Flyash Beneficiation*

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## Step-1

Flyash/powdered subgrade limestone is fed into a thin gap between parallel planar electrodes,

- ## Step-2

Unburned **carbon** particles/ Quartz particles in ash take on **positive charge** and **mineral** take on **negative charge** through particle-to-particle contact,

- ## Step-3

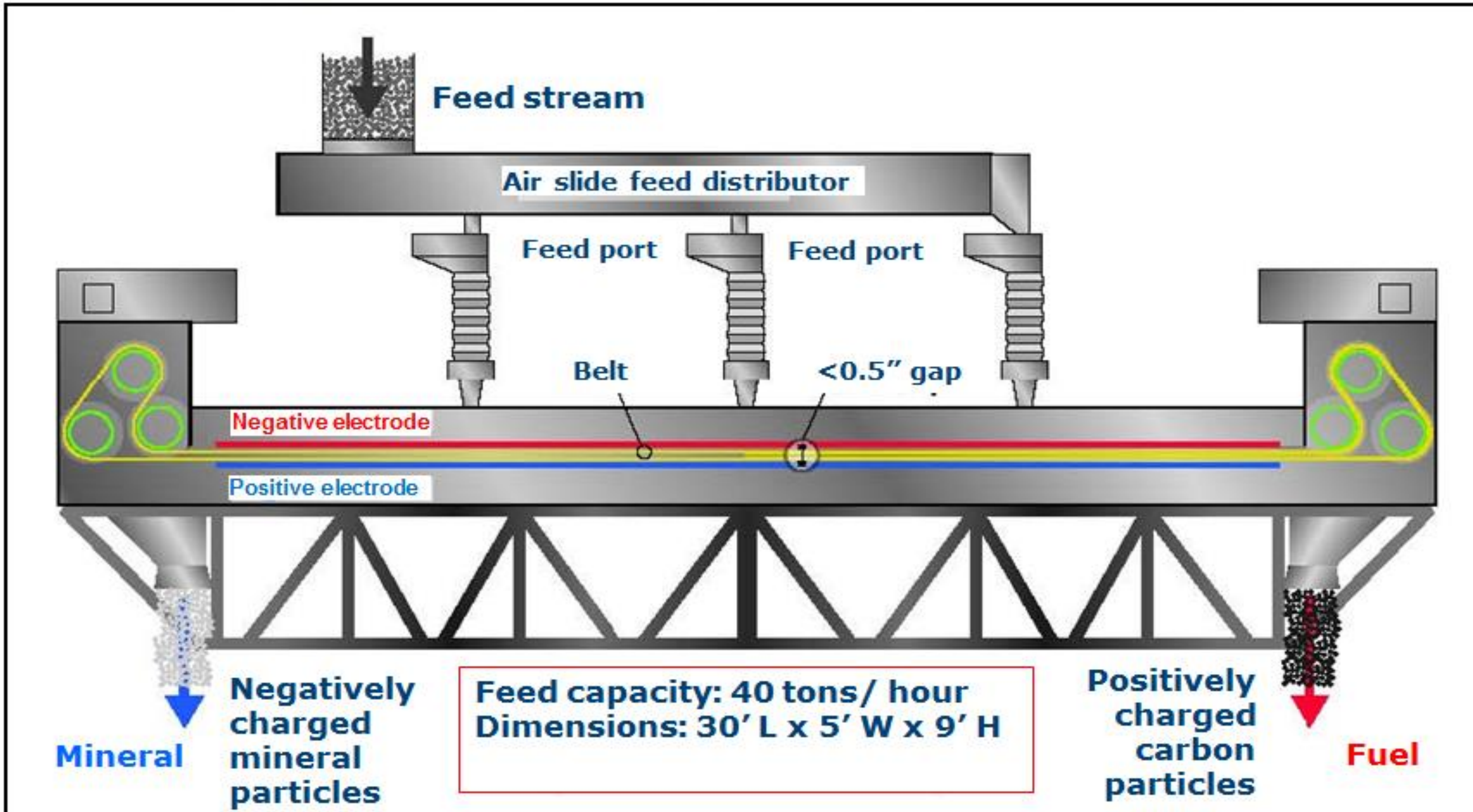
Charged particles are attracted to electrode plate of opposite charge,

- ## Step-4

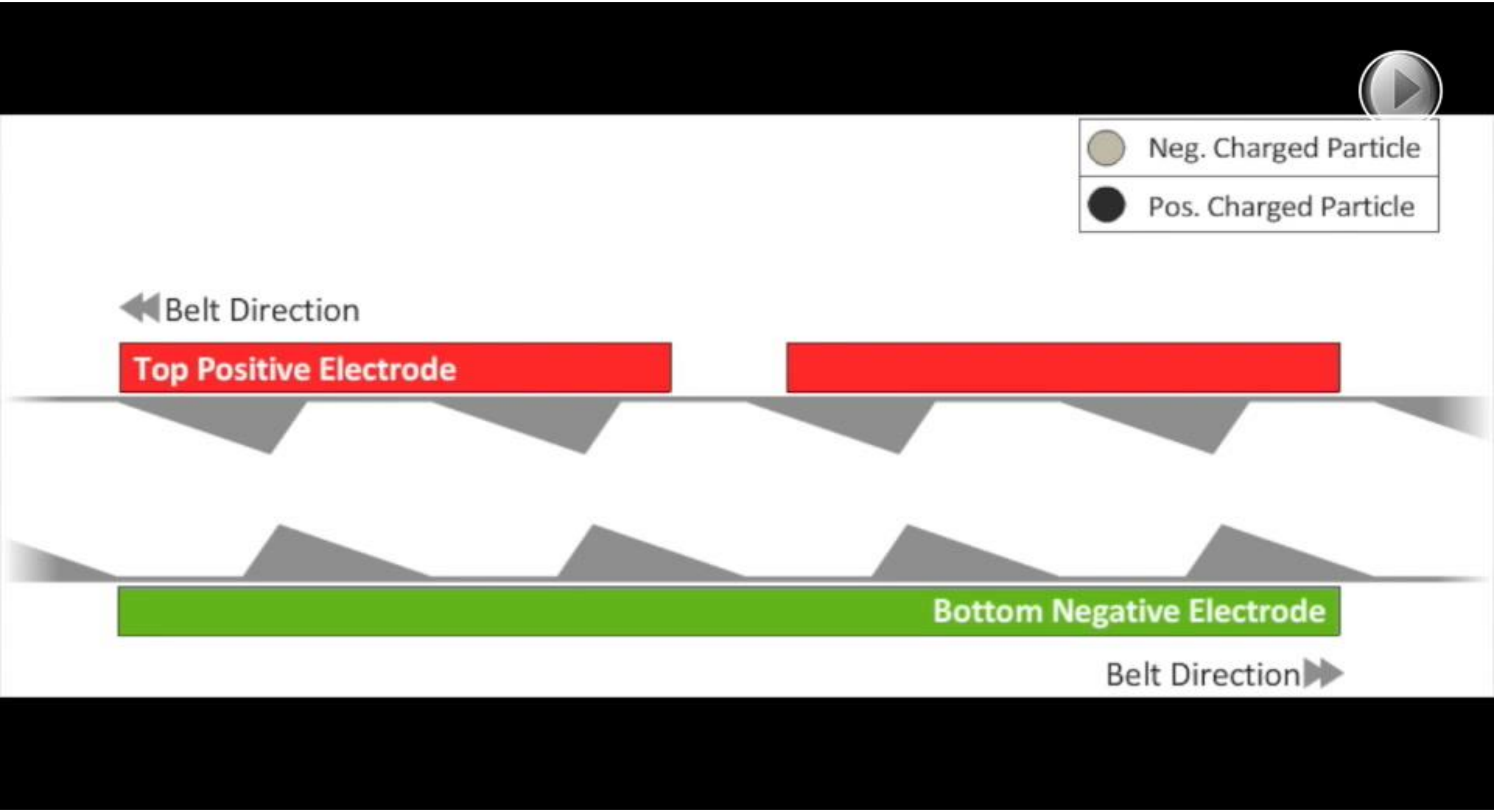
High speed open mesh belt moves differently charged particles in opposite directions.

# Beneficiation Process

*Separator Schematic - Flyash Beneficiation*

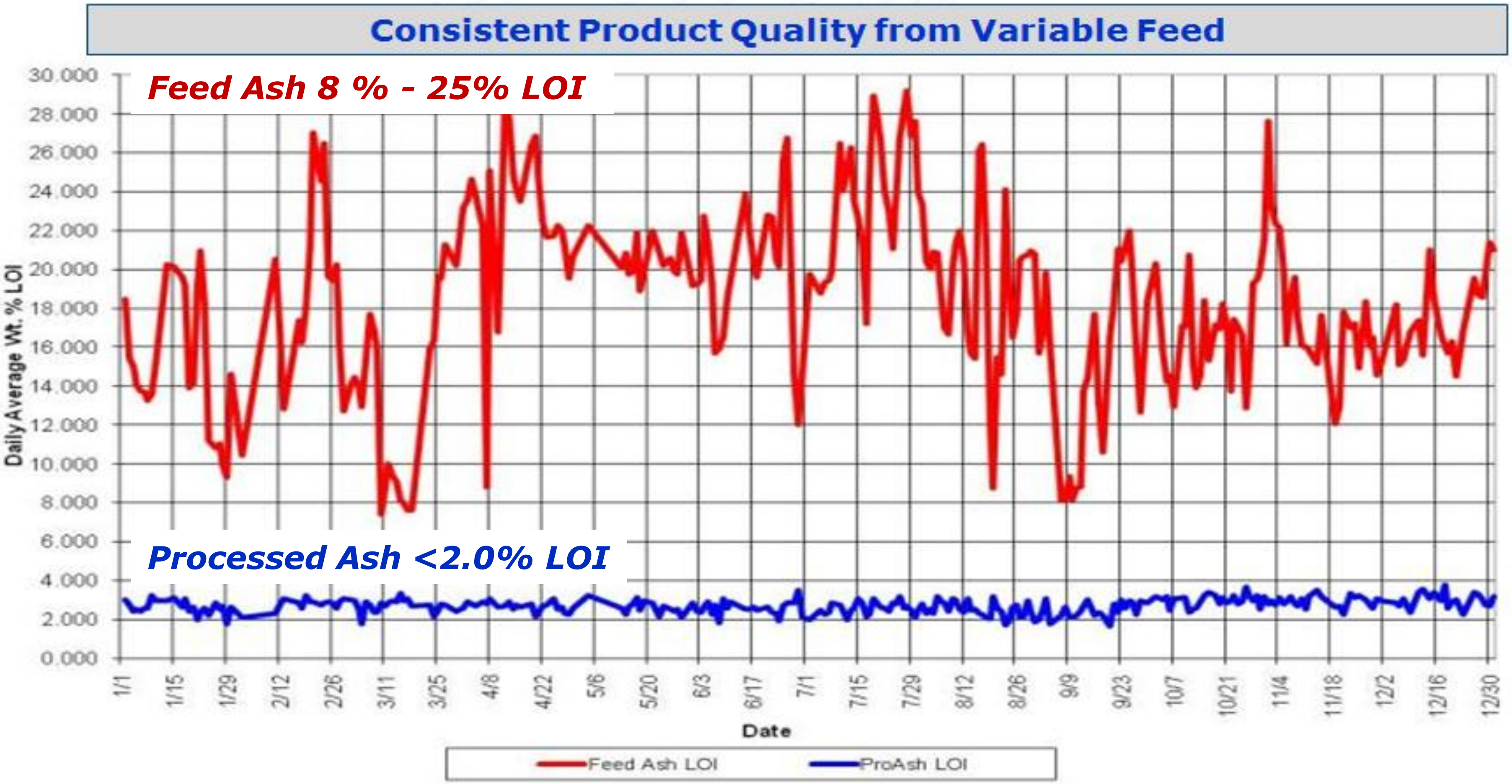


# Beneficiation Process
*Separation Process - Flyash Beneficiation*



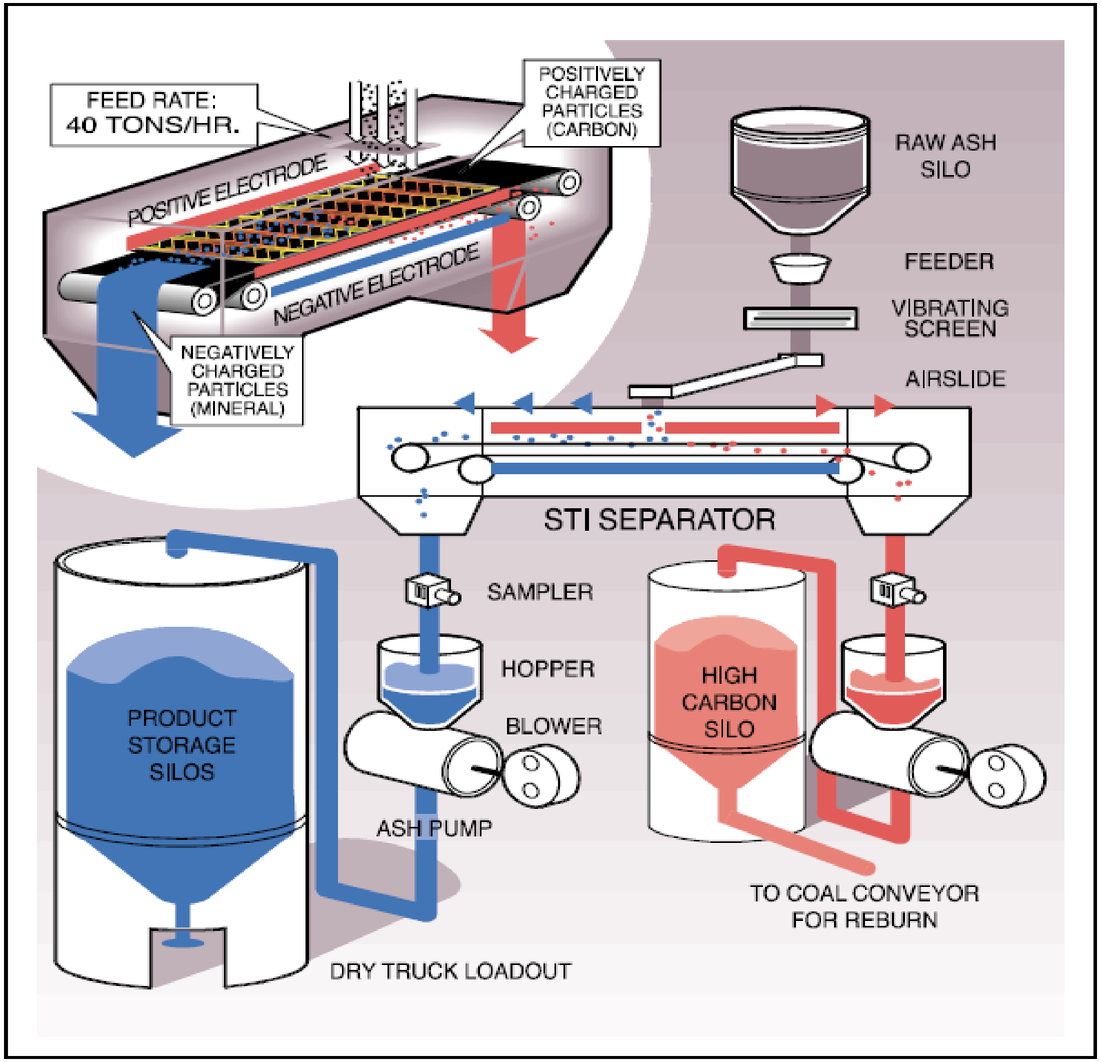
# Beneficiation Process

*Product Quality - Flyash Beneficiation*



# Beneficiation Process

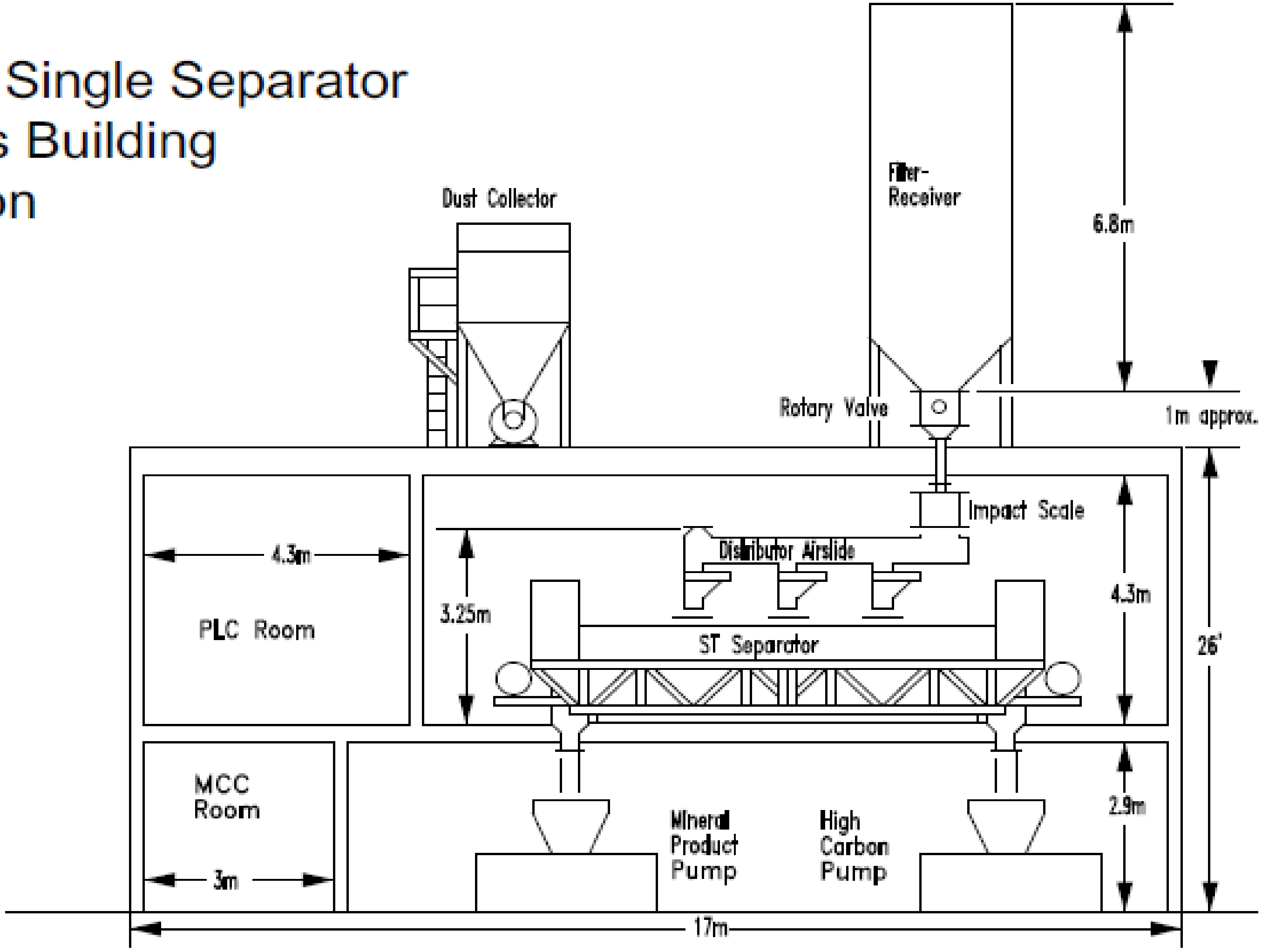
*Plant Layout - Flyash Beneficiation*



# Beneficiation Process

*Foot print & Layout*

Typical Single Separator
Process Building
Elevation



# Beneficiation Process

*Processed Quantity - Flyash Beneficiation*

***+16,000,000 Tons Fly Ash processed***

| Plant | Location | Country | Separators | Comission Date |
|---|---|---|---|---|
| New England Power | Salem, MA |  | 1 | 1995/2006 |
| Duke Energy | Roxboro, NC |  | 2 | 1997 |
| Talen Energy | Brandon Shores, MD |  | 2 | 1999/2005 |
| Scottish Power | Longannet, Scotland |  | 1 | 2002 |
| Jacksonville Electric SJRPP | Jacksonville, FL |  | 2 | 2003 |
| SMEPA | Morrow, MS |  | 1 | 2004 |
| NB Power | Belledune, NB |  | 1 | 2005 |
| RWE | Didcot, England |  | 1 | 2005/2013 |
| Talen Energy | Brunner Island, PA |  | 2 | 2007 |
| TECO | Big Bend, FL |  | 3 | 2008 |
| RWE | Aberthaw, Wales |  | 1 | 2008 |
| EDF Energy | W. Burton, England |  | 1` | 2008 |
| ZGP | Janikowo, Poland |  | 1 | 2011 |
| KOSEP | Yong Heung 5 & 6 |  | 1 | 2014 |
| TBA | Poland |  | 1 | 2016 |
| ZSPS - Siekerki | Poland |  | 1 | 2016 |

# Beneficiation Process

*Electrostatic Mineral Separation Experience*

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| | Separation Achieved | Potential Commercial Application |
|---|---|---|
| Barite – Silicates | ✓ | ✓ |
| Talc – Magnesite | ✓ | ✓ |
| Calcite – Quartz | ✓ | ✓ |
| Feldspar – Quartz | ✓ | ✓ |
| Potash – Halite | ✓ | ✓ |
| Carbon – Aluminosilicates | ✓ | ✓ |
| Wollastonite – Quartz | ✓ | |
| Zircon – Rutile-Ilmenite | ✓ | |
| Magnesite - Quartz | ✓ | |
| Iron Oxide – Silica | ✓ | |
| Phosphate – Silica | ✓ | |
| Aluminosilicate – Flyash | | |
| Beryl – Quartz | | |
| Fluorite – Silica | | |
| Fluorite – Barite – Calcite | | |
| Brucite – Quartz | | |

✓ (red) Separation Achieved

✓ (blue) Potential Commercial Application

# Beneficiation Process
*Testing Application*

**A. Concept of Feasibility Test:**

Evaluation of plant specific material for the separator;

- Potential for differential charging (tribocharging properties);
- Moisture
- Particle size distribution;
- Nature (formation);
- Chemistry, Minerology,

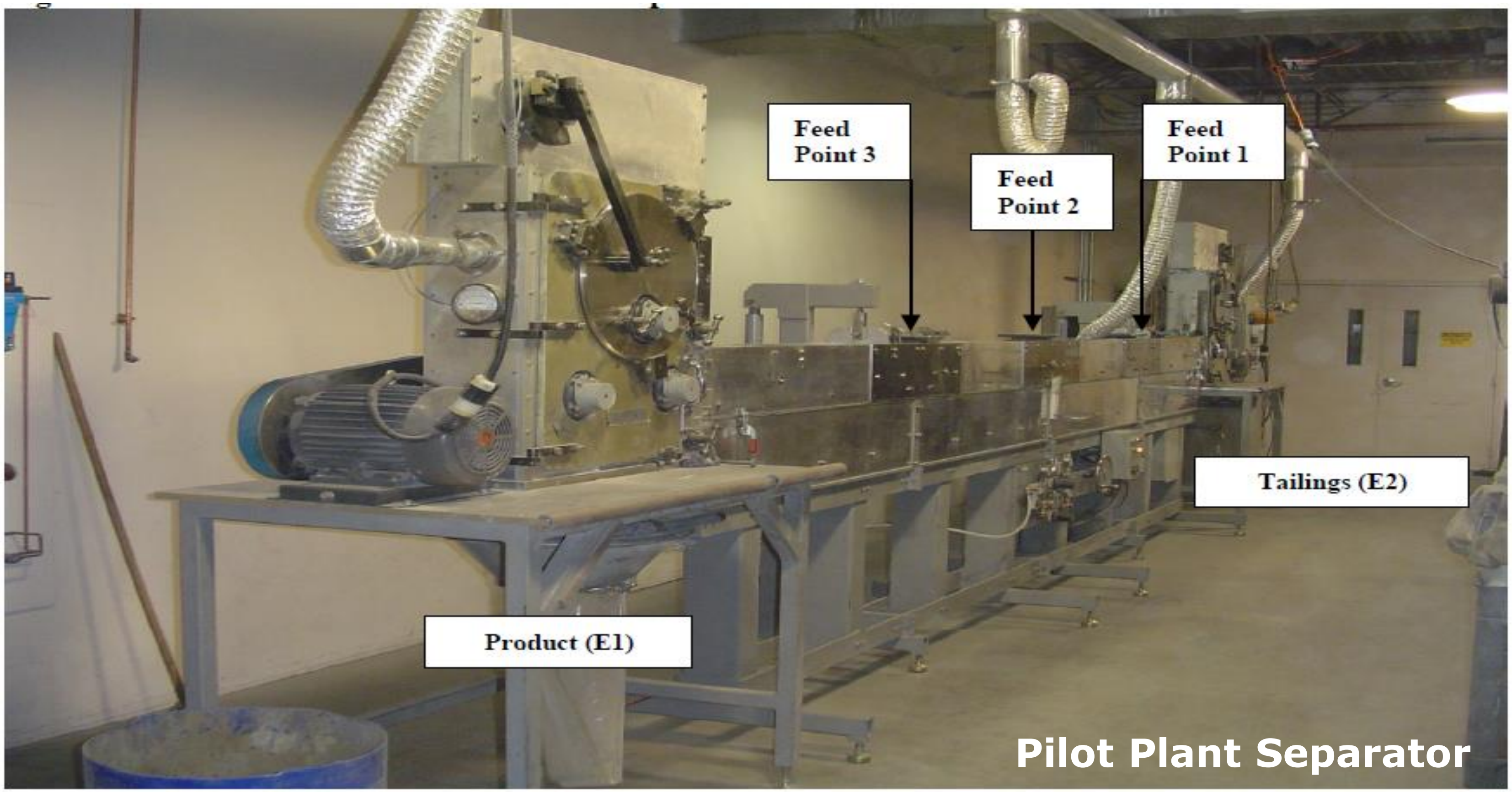
***If Potential Exists!!!!!***

**B. Concept of Pilot Testing**

Evaluation of plant specific material for the separation system;

- Operating parameters
- Feed conditions
- Feed point
- Feed rate
- Feed relative humidity
- Belt speed
- Electrode gap

# Beneficiation Process
*Pilot testing*




- Separator capacity is a function of the width of the electrode area,
- Pilot plant separator **length & configuration** is same for **commercial sized separators**, But width is ~1/7 a commercial M42 (42 inch electrode width) separator.

# Beneficiation Process
*Pilot testing*

| Parameter | Units | Range of Possible Values |
|---|---|---|
| Electrode Polarity | Top electrode charge | Positive and Negative |
| Electrode Charge | kV | 0 – 10 |
| Feed Rate (Pilot Scale) | Short tons / hour (metric tons / hr) | <8 (7.3)[1] |
| Sample Relative Humidity | % RH | <1% – >70%[2] |
| Belt Speed | Feet / Second (m/s) | 10 – 60 (3.0 – 18.3) |
| Feed Point | - | 1, 2 & 3 |
| Electrode Gap | Inches (mm) | 0.350 – 0.700 (8.9 – 17.8)[3] |
| Sample Temperature | °F (°C) | 68 (Ambient) – 160 (20 – 70) |

1 Dependent on material density, particle size distribution and other factors.
2 Dependent on material
3 Dependent on material

# Conserve Resources

## "Effective Utilization of Industrial Waste"

- **Rawmix**
- **Fuelmix**


**Waste to Wealth**

# Industrial Waste – Rawmix
*Conserve Resources*

### Calcareous





### Ferruginous




### Argillaceous/ Ferruginous



### Argillaceous


### Mineralizer


### Calcareous/ Siliceous


### Argillaceous/ Siliceous


***Suitability must be checked before use..***

# Industrial Waste – Rawmix
*Conserve Resources*

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*Suitability must be checked before use..*

| Material | ~ Content | Type |
|---|---|---|
| Waste Hydrated lime - Sugar/Acetylene plant | $CaO$ = 50-70% | Calcareous |
| Sugar Sludge - Sugar plant | $CaO$ = 40-45% | Calcareous |
| Calcined lime – Soda ash plant | $CaO$ = 40-45% | Calcareous |
| Lime sludge - Calcium carbide plant | $CaO$ = 60 – 65% | Calcareous |
| Waste slag - Steel/Phosphorous/Alumina plant | $CaO$= 30-40%<br>$SiO_2$= 30-40% | Calcareous<br>Siliceous |
| Flue dust - Steel plant | $Fe_2O_3$= 40-50% | Ferruginous |
| Mill scale – Metal extrusion plant | $Fe_2O_3$= 60-90% | Ferruginous |
| Red Mud – Alumina plant | $Al_2O_3$=15-25%<br>$Fe_2O_3$= 45-85% | Argillaceous<br>Ferruginous |
| Fluoride Waste - Alumina plant | F = 12-20% | As Mineralizer |
| Waste Bottom ash – Thermal power plant | $SiO_2$=50-60%<br>$Al_2O_3$= 20-30% | Siliceous<br>Argillaceous |

# Industrial Waste – Fuelmix

*Conserve Resources*


**Suitability must be checked before use!!!**

# Industrial Waste – Fuelmix
*Conserve Resources*

# Industrial Waste – Fuelmix
*Conserve Resources*


- Produced by drying & briquetting
  - Chopped wood
  - Agricultural waste
  - Bio mass.
- Better heat value (~4000Cal/g)
- Cheaper than coal and wood
- Consistent quality
- Low-level of emission
- No moisture contents
- High volatile matter
- Low ash content

# Industrial Waste

*FLS – Contribution*

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**Case Studies**

**Alkali Bypass Dust**

**Wastes of Paper Plant**

**Wastes of Carbide plant**

**Wastes of Alumina Plant**

**Waste of Soda ash plant**

**Waste of mines**

Together
Everyone
Achieves
More

# Operational Support Services

Productive Me


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