

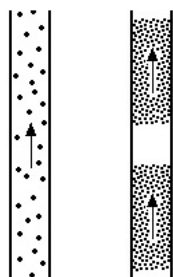
Developments in Bulk Material Elevation Technology

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Introduction

- Elevation of bulk materials → Essential requirement in many industrial plants and processes
- Current popular methods:

Dilute Dense



Pneumatic
Conveyor



Screw
Conveyor



Bucket
Elevator

Introduction...

However → Problems & Limitations :

1. Pneumatic Conveying:

- Relatively high op. costs, velocities, wear rates and particle damage (esp. dilute)

2. Screw Conveying:

- Relatively high op. speeds (slippage) and particle attrition
- Back-flow of material
- Undesirable casing/screw contact

3. Bucket Elevators:

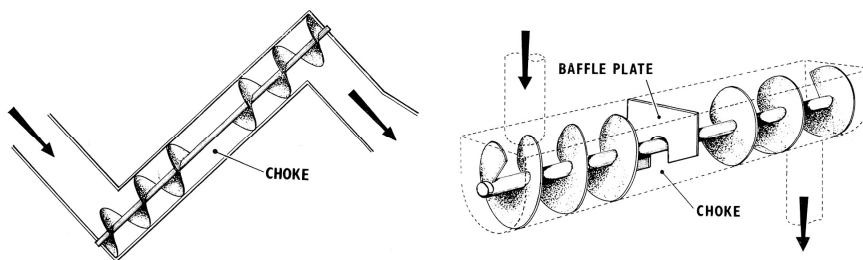
- Relatively high capital/maintenance costs
- Mistracking of belt/chain
- Damage to belt/chain, buckets, casing...



Introduction...

Also → Fire & Explosion Hazards :

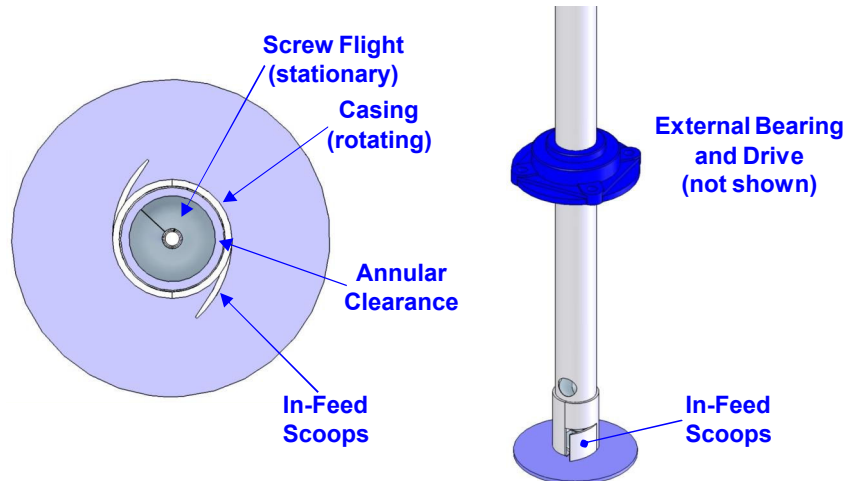
1. Increased risk of dust explosion due to:
 - Mech damage or impact → Sparking
 - Overheating bearings/pulleys → Ignition
 - Bucket-product shearing → Frictional heating
 2. Dust clouds inside elevator
 3. Dust generation mechanisms:
 - Particle-particle & particle-wall impacts
 - Particle attrition
 - Turbulence and induced/entrained air
 4. Propagation of dust explosion → Elevator
- Expensive Explosion control req'd:
Venting, Suppression, Isolation...



Product Explosion Barriers or “Chokes” [2]

New Elevation Technology

- Novel type of elevator (Olds Elevator) →
Developed to overcome or avoid problems:



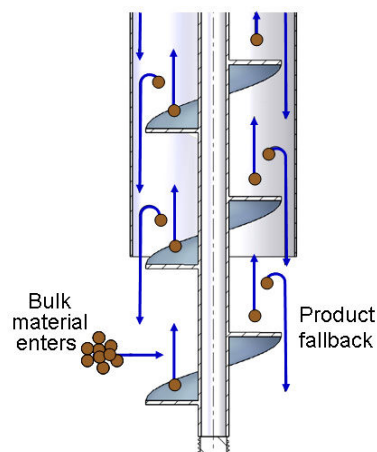
Unique Design and Operating Characteristics

- Stationary screw, Rotating casing, Compact design
- External bearing/s and Drive (not in contact with bulk material)
- Self-feeding
- Accurate feed rate control (excellent turndown ratio)
- Generous clearances
- No back-flow (loss) of material

Unique Design and Operating Characteristics...

- Greater transport efficiency (c/w conv. vertical screws)
- Full-bore mode of flow (smooth, steady and no “pulses”)
- Suitable for powders and granular materials
- Minimal particle attrition and dust generation (even with fragile particles)
- Can handle difficult, hot, abrasive or corrosive bulk materials

Unique Design and Operating Characteristics...

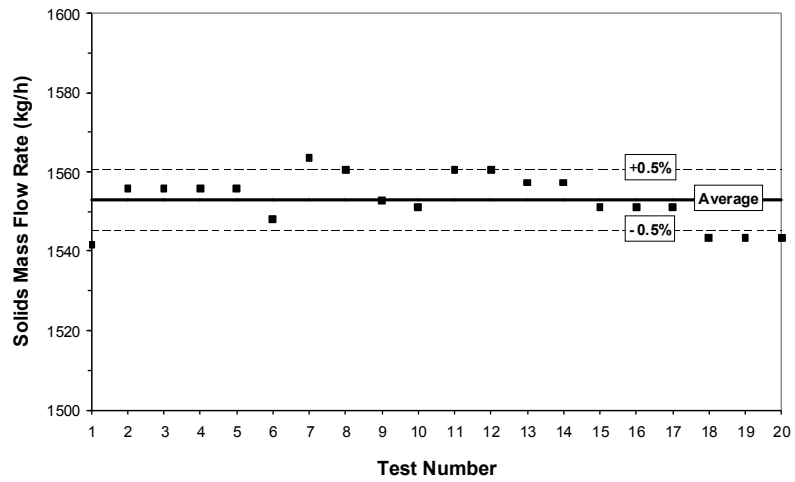


Conventional Vertical Screw



Olds Elevator (full-bore flow)

Repeatability Tests - Sulphur Pastilles (standard elevator)



➤ Design enhancements → Better accuracy

Case Studies

Original Elevator
(foundry sand)

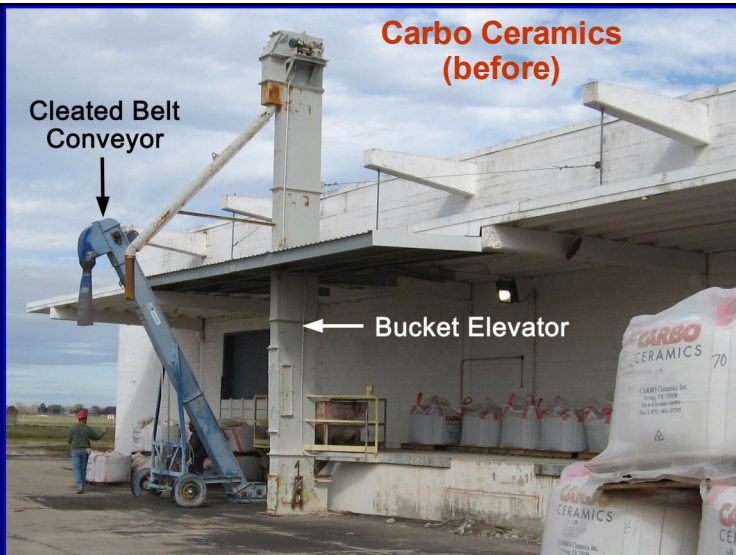


Bean Growers



- 2 × Olds Elevators replaced 3 × Bucket Elevators and 1 × Inclined Screw
- Saved capital, Space & Quieter operation

Carbo Ceramics (before)



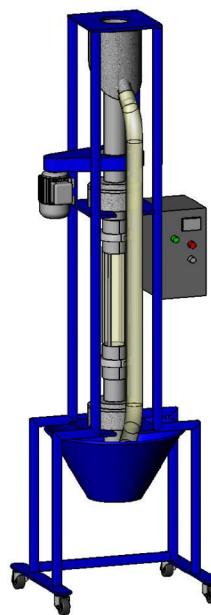
- Difficult/costly product change-over
- Extra conveyor needed
- Dedicated bucket elevator & Inefficient operation



- **Fast change-over and clean-up times**
- **No particle damage or dust**
- **35 t/h**

Further Research

- **New test rig at UoW → Explore full potential of Olds Elevator:**
 - ❖ **In-feed scoop designs**
 - ❖ **Screw flight designs**
 - ❖ **Capacity modelling**
 - ❖ **Material property effects (d , ρ_s , δ , ϕ_w , etc)**



Recirculation (demo) Mode

Conclusions

- 1. New type of Elevator avoids many problems experienced by traditional equipment (bucket, screw, pneumatic conveyors)**
- 2. Due to its full-bore mode flow:**
 - ❖ Transport efficiency increased
 - ❖ Explosion ignition/propagation hazards avoided
 - ❖ Expensive explosion control equip avoided
- 3. External bearings: Minimise mtce costs; Allow handling of difficult, hot and abrasive bulk materials**
- 4. Particle damage/dust generation minimised**