Understanding Pneumatic Conveying makes vital decisions much easier.

A comprehensive, interlocking group of system types is required to meet the needs of a wide variety of applications in every process industry involving bulk materials handling.

From pebble lime to peanuts, from coal to baby powder - and everything in between - Macawber has the technology, the hardware, and the experience to design and supply the proper technology group for reliability and life cycle economy.

Selecting the correct pneumatic conveying regime for your requirements is a vital decision for a successfully designed system.

Almost all applications will benefit from a regime providing the heaviest line loading and the lowest material velocity. These attributes also provide the greatest conveying gas economies for efficient power consumption.

Typical Conveying Regimes

1. **Solid Dense Phase** - Very low material velocity, pipeline full of material - an excellent regime for fragile materials.

2. **Discontinuous Dense Phase** - Low material velocity - with high line loading ... material moves in plug flow fashion - best regime for most applications in which power economy, pipe erosion, and material degradation issues are important.

3. **Continuous Dense Phase** - Higher velocity than discontinuous dense phase, but much lower than dilute phase. Used for handling fluidizeable powders.

4. **Dilute Phase** - Material velocity above the saltation velocity - no upper limit to the velocity - least attractive regime for operating economy - unsuitable for fragile or abrasive materials or materials with wide particle size distribution.

Macawber’s philosophy is a scientific approach to design with unmatched innovation and experience. We realize that every system is different and each company has different needs.

Therefore, before we present any recommendations, we carefully review the two major issues of any bulk handling system: material characterization and the system design objectives.

The result? An optimized design for your individual needs, which addresses both technical and economic considerations, backed up with a wealth of experience.

### Considerations

#### Material Characterization
- Particle size and distribution
- Bulk density
- Moisture content
- Flowability
- Chemistry
- Abrasiveness
- Friability
- Temperature
- Permeability

#### Design Objectives
- Transfer rate
- Transfer or injection
- Positive or negative pressure
- Distance and conveying route
- Feed consideration
- Conveying medium type
- Material integrity
- Velocity / pipewear
- Operating cost

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U.S. Department of Energy
Harford, Washington, USA
MARKET DIVISION: Combustion - Industrial
PRIMARY APPLICATION OBJECTIVES:
1. Minimum particle size degradation
2. Low operating cost
3. Minimum peanut meal accumulation
4. Elimination of spillage

Shanghai Coking and Chemical Plants
Wujin, China
MARKET DIVISION: Combustion - Utility
PRIMARY APPLICATION OBJECTIVES:
1. Ability to reduce pressure to atmosphere and convey ash at low velocity to a storage bin
2. Weigh and record all material conveyed to the bins
3. Low piping
4. Operate at 650 °F for sustained periods of time

Hershey Foods
H.B. Reese Division
Hershey, Pennsylvania, USA
MARKET DIVISION: Food and Pharmaceuticals
PRIMARY APPLICATION OBJECTIVES:
1. Minimum damage to peanuts
2. Minimum peanut meal accumulation
3. Operating reliability
4. Elimination of spillage

Technology Groups
Macawber has developed a range of technology groups to reliably and economically satisfy a diverse array of market requirements. The technology groups collectively respond to the entire spectrum of pneumatic conveying regimes and individually satisfy application-specific needs.

DENSEVEYOR® L.D. Low velocity conveying system designed for dry, fluidizable powders at rates up to 100T/hr. where conveying distances are extended. Air flows are minimized, and energy consumptions comparatively low. Materials can be conveyed up to 5000 ft.

DENSEVEYOR®® The ultimate system for handling difficult-to-convey materials; hot, abrasive, and wet materials, or for providing gentle handling of products to prevent degradation of friable materials or separation of blended materials.

ASHVEYOR®® Designed specifically for conveying hot, abrasive ash. The Macawber Ash Conveying System will convey bottom ash, cinders, or fly ash from boiler beds, baghouse, or electrostatic precipitators at temperatures up to 650°F, and may be arranged in multiples of one to ten units in a single line. Uses about 50% less power than existing fly ash conveying systems.

SANDPUMP®® Designed specifically for dry sand conveying. The Macawber Sandpump®® is based on proven dense phase pneumatic principles. An introduction, simplified system controls, and top discharge have been designed specifically for this use. The Sandpump®® can be manufactured without custom modifications and sold "off-the-shelf" for fast, easy installation.

VARIFLOW®® Low-cost, simple transfer systems for medium duty applications using a low pressure air source with a unique method of preventing pipeline blockages while maximizing conveying capacity. A unique approach for increasing transfer capacity in dilute phase pneumatic conveying systems.

SUPER DENSEVEYOR®® An important development of the DENSEVEYOR®, the Super DENSEVEYOR® achieves a solid dense phase conveying regime for very low material velocities and little or no degradation of the most fragile materials, such as food products.

ASHVEYOR®® A unique system which provides accurate injection of powders and granular materials up to distances of 600 feet with flow accuracies of ± 1%. Material can be injected against high, varying back pressures without loss of accuracy and with smooth, unpulsed flow. 10:1 turndown is provided as standard.
The Dome Valve is unique in its ability to close and seal in one action through a static or moving column of material entering the conveying pressure vessel. This feature ensures complete filling of the vessel and a simple control philosophy that does not rely on level probes fitted into the vessel.

Pressure-tight sealing against a pressure differential when handling abrasive materials is achieved with an inflatable elastomeric seal engaging the periphery of the dome component. The inflatable seal entraps particles preventing wear by erosion to the valve seat and seal. These advantages are maintained even through severe application conditions for abrasion, temperature and high pressure.

The Dome Valve® is rated at 1 million cycles between inspections, virtually eliminating costly maintenance and down-time. Every Macawber system is fitted with the Dome Valve® to ensure operating reliability and system efficiency.

Market Divisions

Each market requirement for pneumatic conveying or process injection brings its own list of special considerations.

With more than twenty years of experience working around the globe, Macawber literally brings a world of knowledge to each of our market divisions, a special benefit in which our customers find great value.

Our technology groups apply across the range of market divisions, with the added benefit of cross-application experience.

Market divisions served by Macawber include:

- Basic Metals
- Chemicals
- Food / Pharmaceuticals
- Plastics / Resins
- Minerals
- Pulp and Paper
- Combustion Systems (Industrial)
- Combustion Systems (Utilities)
- Miscellaneous Processes and Applications

[Image of System Diagrams]
**Allen Sugar**

Cleveland, Ohio, USA

MARKET DIVISION: Food and Pharmaceuticals

PRIMARY APPLICATION OBJECTIVES:
1. Minimum particle size degradation
2. Low operating cost

Allen Sugar required the most modern handling system for fragile granular sugar and dextrose without any change to the product grain size or shape. Exacting degradation limits were established for pre-contract engineering. Macawber satisfied all objectives with negligible degradation of the sugar granule or the dextrose material.

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**Westinghouse Bay Resources**

Bay Resources Management Center

Panama City, Florida, USA

MARKET DIVISION: Combustion - Industrial

PRIMARY APPLICATION OBJECTIVES:
1. System reliability: garbage incinerator ash contains residues from combustion of plastics, plus a high moisture content. The result is a sticky, light fly ash which can bridge and stick in hoppers if they are not correctly designed.
2. Low pipe wear
3. Low energy consumption

Two Ashveyor® systems were installed, each collecting from four hoppers. The ash is delivered to surge bins feeding tubulars where the fly ash is pelletized and discharged into the bottom ash stream. The systems have operated very successfully for many years with only occasional (mild steel) bends requiring replacement. The straight pipe lengths were still intact after ten years of operation.

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**China Cement**

Hong Kong, China

MARKET DIVISION: Minerals

PRIMARY APPLICATION OBJECTIVES:
1. Retrofit existing screw pumps re-using existing pipelines and air supply
2. Reduce energy consumption
3. Reduce maintenance costs
4. Optimize conveying rate

Each material is handled by Macawber Macpumps® using a horizontal configuration. The Macpump® transfer vessel is located below the modified existing feed hopper. The material is transferred to the Macpump® dispensing vessel which is adjacent to the transfer vessel and connected into the existing pipeline. The Macpump® saved between 100 kw and 200 kw per system for a total savings of 1300 kw.

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**Great Lakes Carbon**

Port Arthur, Texas, USA

MARKET DIVISION: Chemicals

PRIMARY APPLICATION OBJECTIVES:
1. Minimum particle size degradation
2. Low pipe wear
3. Operating reliability

Great Lakes Carbon was new to pneumatic conveying. Traditionally all materials have been transferred by mechanical conveyors causing dusting and spillage. The product particle size could not be degraded without affecting the value of the product now in its final stage of handling before ship loading. The pipe routing was ambitious, including a final vertical rise of 123 ft. We met the requirements and established a new standard for modern handling at Great Lakes Carbon.

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**Engineering and Process Testing**

Macawber possesses a comprehensive resource of experienced engineers to support pre-contract and post-contract requirements.

Process testing services are centered upon a purpose-built, full-size conveying systems laboratory in which conveying circuits of up to 2000 ft. are installed.

The conveying circuits are equipped with instrumentation and data acquisition facilities that provide a wide range of information relating to the efficiency of the pneumatic conveying process. Post-contract engineering resources ensure that the contract is executed with full regard to the contract requirements utilizing advanced design methods and programs.

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**Manufacturing**

Macawber has maintained a philosophy of self sufficiency for the manufacture of our products. Since 1980, the company has possessed a National Board License for the design and manufacture of ASME Section VIII Division 1, U and UM Code stamped vessels. Special pressure vessels for pneumatic conveying systems have been produced for design pressure to 500 psig.

In-house machining operations and system control panel production ensures that we have tight control of our costs and quality requirements at each stage of the process. The company has also been awarded a TÜV license for the production of pressure vessels for use in Germany and other European countries.
**Nestle Raisins**
Burlington, Wisconsin, USA

**MARKET DIVISION:** Food and Pharmaceuticals

**PRIMARY APPLICATION OBJECTIVES:**
1. Successfully feed and discharge raisins in a dense phase Denseveyor® transporter
2. Convey raisins without causing damage to the product
3. Easy access for cleaning operations
4. Provide batch weighing of raisins and controlled feed onto coating tray

The customer produces chocolate covered raisins. The raisins are supplied to the customer in the form of “bricks.” The raisins are carefully separated and transported to a coating machine. If the raisins are roughly handled, the skins tear and syrup escapes, ruining the product. The second problem is that the raisins will, under pressure, reclump, which makes them unsuitable for the coating process.

Macawber provided a Denseveyor® low velocity conveying system with a special agitator system which ensured that the raisins did not reclump when the vessel was pressurized. The Denseveyor® was designed with a removable top which can be quickly swung away on a hinge to allow easy access into the vessel for periodic cleaning.

**B.F. Goodrich**
Oevel, Belgium

**MARKET DIVISION:** Plastics and Resins

**PRIMARY APPLICATION OBJECTIVES:**
1. Operating reliability
2. Low energy cost

B.F. Goodrich required absolute system performance and operating reliability. The customer researched specialist vendors on two continents for this important expansion to their facilities. The resin powders exhibit unique characteristics, and experience with this material became a fundamental requirement. All systems were installed on time to specification and performed as required.

**BASIC DATA:**
- 7” 4” low velocity Denseveyor® systems
- 2 to 4 reception points
- Resin powders

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**Research and Development**

Macawber has consistently contributed to the general development of pneumatic conveying technology over the years.

Through original research and progressive development of original concepts and designs, Macawber has maintained a lead in the specialization of low velocity pneumatic conveying technology.

The purpose built Research and Development facility incorporates a materials characterization laboratory for detailed examination of the mechanical properties of bulk materials.

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**Brunner Mond**
Northwich, England

**MARKET DIVISION:** Chemicals

**PRIMARY APPLICATION OBJECTIVES:**
1. Minimum particle size degradation
2. Operating reliability

Customer manufactures sodium bicarbonate which is used for a wide range of individual and consumer products. The quality of the product depends upon the consistency of the particle size distribution with a severe limit on fines content. To satisfy these requirements, low material velocity is required, which was achieved by the Denseveyor® system.

**BASIC DATA:**
- 1 5” low velocity system
- 1 reception point
- Sodium bicarbonate
- Ambient temperature
- 22 tons/hour

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**Garware Polyester**
Waluj, Aurangabad, India

**MARKET DIVISION:** Plastics and Resins

**PRIMARY APPLICATION OBJECTIVES:**
1. Minimum particle size degradation
2. Operating reliability

Garware were very concerned about destruction of the polyester pellet in their new expansion program. The ten systems represented a major investment in upgrading and expanding their production process. In each, particle degradation was negligible, and all contract objectives were achieved.

**BASIC DATA:**
- 10 4” low velocity Denseveyor® systems
- 2 to 4 reception points
- 5 to 10 tons/hour - 200 ft.
- Polyester pellets/powder
- Ambient temperature

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**Quality Programs**

The company manages several quality programs addressing product quality, product safety and management performance.

- **Pressure Vessel Quality Assurance Certification**
- **Product Safety requirements satisfy the Directives of the European Commission.**
- **ISO 9001**

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**Product Quality Assurance Certification (Germany)**

* Detailed Case Study Available