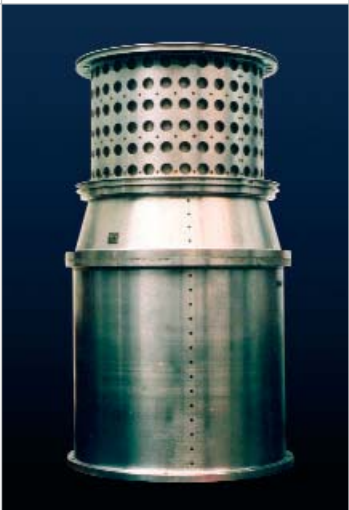




industrial process division

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broadbent decanter centrifuges



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## APPLICATIONS

Some applications of Broadbent decanters :

### PETROCHEMICALS AND POLYMERS

- PURE TEREPHTHALIC ACID (PTA)
- CRUDE TEREPHTHALIC ACID (CTA)
- POLYVINYL CHLORIDE (PVC)
- POLYETHYLENE (HDPE / LDPE)
- BISPHENOL A (BPA)
- POLYPROPYLENE (PP)
- POLYSTYRENE (PS)
- STYRENE CO-POLYMERS (ABS / SAN)
- PARAXYLENE (PX)
- POLYMER RESINS (PMMA / PEEK)

### CHEMICALS, MINERALS AND EFFLUENTS

- CHROMIC AND PHOSPHORIC ACID
- METAL SILICATES, NITRATES, OXIDES
- TITANIUM DIOXIDE
- CALCIUM CARBONATE
- COAL
- POTASH
- KAOLIN AND FINE CLAYS
- DRILLING MUD
- FLUE GAS DESULPHURISATION (FGD)
- PAPER MILL AND TANNERY EFFLUENTS
- LIME SLUDGE
- SUGAR CANE & BEET MUD
- SPENT GRAIN – ETHANOL
- OIL SANDS

## CUSTOMERS

A selection of Broadbent decanter users :

- AGRUIM
- AKER KVAERNER
- BP
- BECHTEL
- BORSODCHEM
- CLEVELAND POTASH
- CVRD
- DOW CHEMICALS
- DUPONT
- EASTMAN CHEMICALS
- EUROPEAN VINYLs
- FLUOR DANIEL
- FORMOSA CHEMICAL AND FIBRE
- FOSTER WHEELER
- FPC
- ICI
- IMC KALIUM
- IMERYS
- INTERQUISA
- INVISTA
- KRUPP UHDE
- MITSUI
- NORSK HYDRO
- RELIANCE
- ROCHE
- SHELL
- SINOPEC
- SM BEET SUGAR CORP
- SOLVAY
- TIOXIDE EUROPE
- VICTREX

# BROADBENT DECANTER HISTORY

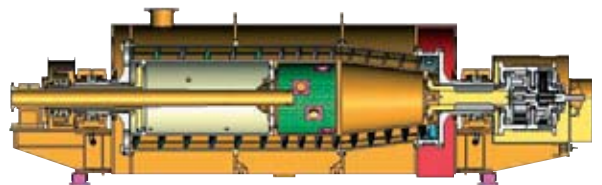
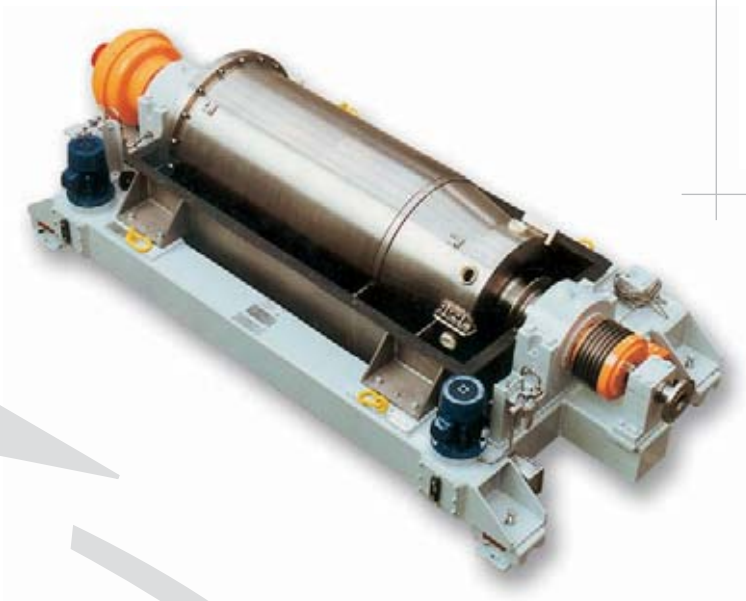
Broadbent have been designing and manufacturing centrifuges since the late 1800's and a huge amount of process knowledge and site experience has been collected over this period. Broadbent use this extensive experience to find and implement solutions to solid – liquid process problems across a wide variety of industries. Broadbent are able to offer process solutions based upon our complete range of centrifuges and solid-liquid separation systems including many types of decanter centrifuges.

For over 50 years, Broadbent horizontal decanter centrifuges have been indispensable in solving solid-liquid separation problems across a wide range process industries world-wide including bulk chemical, petrochemical, pharmaceutical, mineral, oil and gas. Broadbent decanters have also found wide use in environmental applications such as sludge dewatering and industrial effluents.

## The key benefits of decanting centrifuges include :

- **HIGH SOLIDS CONTENT IN DISCHARGED CAKE – LOW CAKE MOISTURE**
- **LOW SOLIDS IN CENTRATE – GOOD SOLIDS RECOVERY**
- **CONTINUOUS OPERATION**
- **HIGH THROUGHPUT**
- **MINIMUM SUPERVISION AND LOW MAINTENANCE REQUIREMENTS**
- **EXCELLENT MECHANICAL RELIABILITY**
- **LOW POWER USAGE**
- **SMALL FOOTPRINT**
- **FULLY SEALED OR FUME TIGHT OPTIONS AVAILABLE**

Broadbent have over 135 years experience of separation using centrifuges and more than 50 years experience of designing, building and commissioning decanting centrifuges.



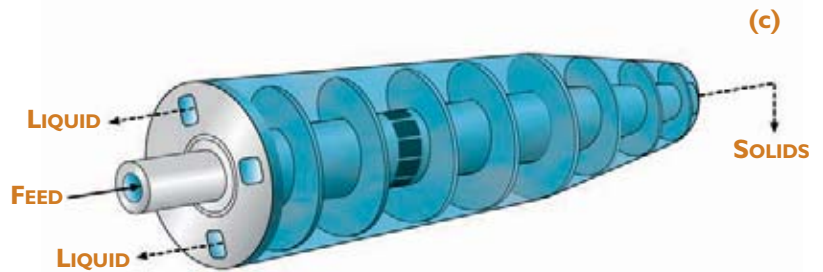
# PRINCIPLE OF OPERATION OF DECANter CENTRIFUGES

The fundamental principle of a decanter centrifuge is accelerated sedimentation under gravity. The sketch (a) opposite shows a simple settling tank with a continuously moving scraper removing the settled solids at the left hand end. The liquid flows over the top of the scraper blades and leaves the tank at the right hand end.

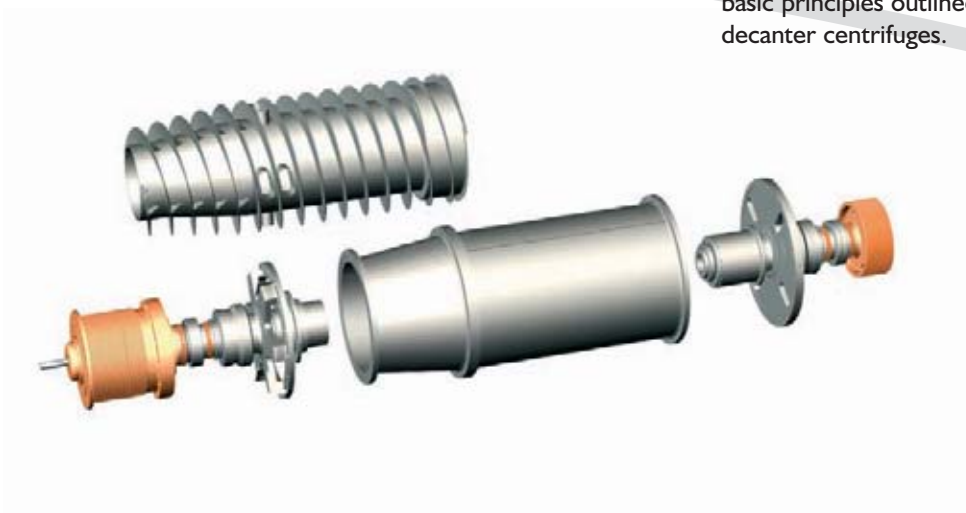


According to Stoke's Law a solid particle within the tank will settle at a rate dependant on a variety of factors including the relative density of the solids and the liquid, the size of the particle and the acceleration due to gravity.

If the tank is transformed, as shown in (b), into a tapered cylinder (c) and the cylinder is then rotated at high speed about its centre line a high centrifugal 'G' force is produced on the liquid and solids. This centrifugal 'G' replaces the acceleration due to gravity in Stoke's Law and results in rapid sedimentation of those particles that are denser than the liquid. The continuously moving scraper in (a) is replaced by the helix shown in (c) which transports the solids out of the tapered end of the cylinder allowing continuous separation. The original settling tank (a) has now been transformed into a decanting centrifuge (c).



There are many variations of decanting centrifuges in use in a wide variety of process applications; however the basic principles outlined above apply to all types of decanter centrifuges.



# SOLID BOWL DECANTER CENTRIFUGE



Feed slurry is introduced into the bowl through the centre of the conveyor where the solids settle through the liquor pool formed in the bowl. The gearbox produces a slight differential speed between the rotation of the bowl and that of the screw conveyor which conveys the solids along the bowl wall, out of the liquor pool, and up the conical section of the bowl to the solids discharge ports. The clarified liquor (centrate) discharges continuously from the opposite end of the bowl over adjustable weir ports.

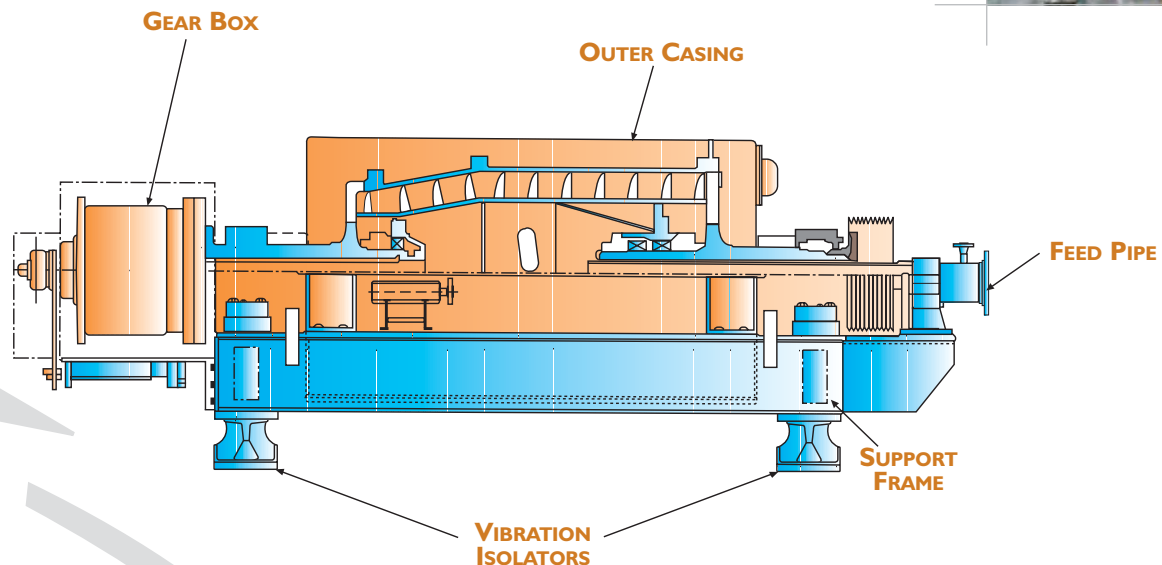
## Typical operating conditions & performance

- **FEED SLURRY 1 - 45% SOLIDS W/W**
- **DISCHARGED SOLIDS 5 - 70% LIQUID W/W**
- **SOLIDS RECOVERY 60% - 99.95% W/W**
- **THROUGHPUTS 3 - 200 M<sup>3</sup>/HR**
- **SOLIDS OUTPUT 0.2 - 100 TONNES/HR**
- **FEED PARTICLE SIZE - ZERO TO APPROX 10MM**
- **BOWL SPEED 500 - 3500 RPM**
- **POWER CONSUMPTION 25 - 500 kW**
- **FEED TEMPERATURE -69°C TO 200°C**
- **CASE PRESSURE. VACUUM TO 10 BARG**

## WITH OPTIONAL FEATURES SUCH AS :

- **INERT GAS PURGING**
- **FUME TIGHT OR FULLY SEALED DESIGNS**
- **VARIABLE SCROLLING RATE**
- **VARIABLE BOWL SPEEDS**
- **CAKE WASHING**
- **CHEMICAL & POLYMER ADDITION**
- **SPECIAL PROTECTION FOR ABRASION RESISTANCE**

Employed as a classifier, the solid bowl decanter centrifuge can selectively remove solids from a suspension and classify solids as coarse as 50 micron or as fine as one micron.

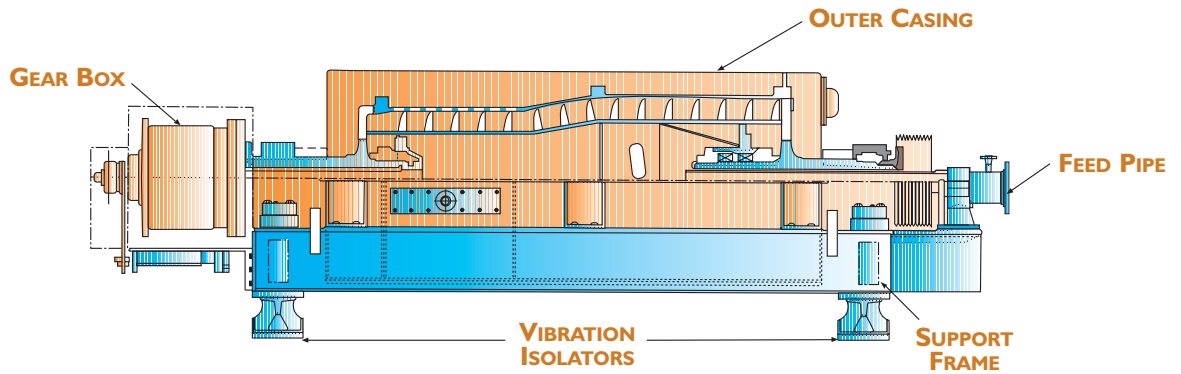


# SCREEN BOWL DECANTER CENTRIFUGE

This type of decanter is a development of the solid bowl where separation occurs in two stages. In the first stage clarification and sedimentation take place as in a solid bowl decanter centrifuge. The second stage allows further dewatering as the solids are conveyed over a perforated screen section. In addition the solids can be washed whilst on the screen and, if required, the wash liquor can be collected separately.

## Benefits of screen bowl decanter centrifuge :

- PERFORMANCE IS NOT GREATLY AFFECTED BY VARIATIONS IN FEED CONSISTENCY
- MOTHER LIQUOR AND WASH LIQUOR CAN BE COLLECTED SEPARATELY
- FINAL DRAINAGE THROUGH SCREEN ENSURES LOW CAKE MOISTURE
- ABILITY TO WASH CAKE AND COLLECT WASH LIQUORS
- LIMITED PRODUCT LOSSES THROUGH SCREEN



# THREE PHASE DECANTERS

A three-phase slurry – such as oil, water and solids – can be continuously and efficiently separated into its three distinct constituent streams in a three phase solid bowl Broadbent decanter.

Decanters are particularly well suited to applications where there is a high level of solids in the feed slurry – typically in excess of 5% dry solids.

## Typical separation applications using a three phase decanter :

- TANK BOTTOMS
- PALM & OLIVE OIL

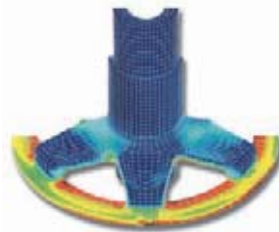
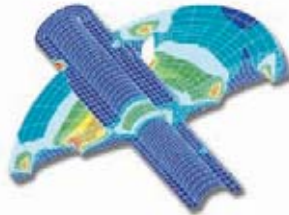


# DECANTER DESIGN & MANUFACTURE

All Broadbent decanters are designed and built to BS12547 & ISO9000 and other international standards for design and manufacture. Broadbent are also an ASME certified manufacturer of pressure vessels. Our main manufacturing facility in Huddersfield, UK is equipped to manufacture all rotating components in a wide variety of materials of construction selected to suit the rigours of the particular process application. Materials of construction for the bowl, conveyor and casing of the decanter include :

- **STAINLESS STEELS**
- **DUPLEX STAINLESS STEELS**
- **MILD STEEL**
- **MONEL**
- **HASTELLOY**
- **TITANIUM**
- **NICKEL**
- **INCONEL**

For example, for PTA dewatering; super duplex stainless steels are used for some solid bowl pressure tight decanters designed to operate at 10 barG and 200°C. Titanium is used for high temperature extraction of salt from a saturated solution or other corrosive environments.



# SERVICE & SUPPORT

Broadbent have a team of over 50 multi-skilled engineers familiar with all aspects of centrifuges – whether those of Broadbent or of other manufacturers. This team provides extended support, from routine maintenance and provision of spares, through installation, commissioning and operator training to full on-site service contracts.

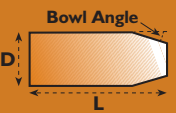





Broadbent service division (BCSL) is able to refurbish and provide enhancements to the process performance of other manufacturer's decanters. For example decanter upgrades and optimisation carried out on a PTA plant in Spain have increased the decanter throughput by 40%, reduced maintenance and improved the stability of the process.



## SIZE RANGE

|                     |     |     |       |       |       |       |       |       |       |       |
|---------------------|-----|-----|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>MODEL :</b>      | 150 | 225 | 450   | 550   | 600   | 750   | 900   | 1000  | 1200  | 1400  |
| <b>DIAMETER M</b>   | 150 | 225 | 450   | 550   | 600   | 750   | 900   | 1,000 | 1,200 | 1,400 |
| <b>LENGTH M MIN</b> | 300 | 700 | 700   | 1,375 | 950   | 1,875 | 1,800 | 1,500 | 2,100 | 1,800 |
| <b>LENGTH M MAX</b> | 500 | 900 | 1,100 | 1,375 | 2,100 | 2,500 | 3,000 | 1,500 | 3,600 | 3,600 |
| <b>TYPICAL WT T</b> | 1.0 | 1.7 | 2.5   | 3     | 4.8   | 8     | 14    | 12    | 25    | 30    |
| <b>MOTOR kW MIN</b> | 5   | 11  | 15    | 30    | 30    | 55    | 60    | 75    | 110   | 110   |
| <b>MOTOR kW MAX</b> | 11  | 18  | 30    | 60    | 75    | 135   | 150   | 200   | 500   | 500   |
| <b>TYPES :</b>      |     |     |       |       |       |       |       |       |       |       |
| <b>SOLID BOWL</b>   | ✓   | ✓   | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| <b>SCREEN BOWL</b>  |     |     | ✓     | ✓     | ✓     | ✓     | ✓     |       | ✓     | ✓     |
| <b>FUME TIGHT</b>   | ✓   | ✓   |       | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| <b>PRESSURE</b>     |     |     |       |       | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| <b>THREE PHASE</b>  |     |     |       |       | ✓     | ✓     | ✓     |       |       |       |

## TYPICAL DECANTER BOWL PROFILES

|   |       |     |            |  |       |         |             |
|---|-------|-----|------------|--|-------|---------|-------------|
|  | 2.5:1 | 15° | SOLID BOWL |  | 3.0:1 | 15°- 3° | SOLID BOWL  |
|  | 3.0:1 | 10° | SOLID BOWL |  | 3.0:1 | 15°     | SCREEN BOWL |
|  | 3.5:1 | 7°  | SOLID BOWL |  | 3.5:1 | 15°     | SCREEN BOWL |



# DECANTER OPTIONS

## Decanter Sealing & Purging

Broadbent decanters are available with a variety of sealing systems to contain any hazardous chemicals within the decanter casing. If inert gas purging is required Broadbent can provide suitable systems which maintain positive flow purging, gas blanketing, and includes all the necessary gas analysers, controls and alarms.

## Fume Tight Decanters

Many applications require the decanter casing to sustain a slight overpressure whilst avoiding the discharge of hazardous vapours and liquids. A variety of sealing solutions are available including :

- **NITROGEN BARRIER LABYRINTH SEALS**
- **CARBON BUSHING SPLIT RING SEALS**

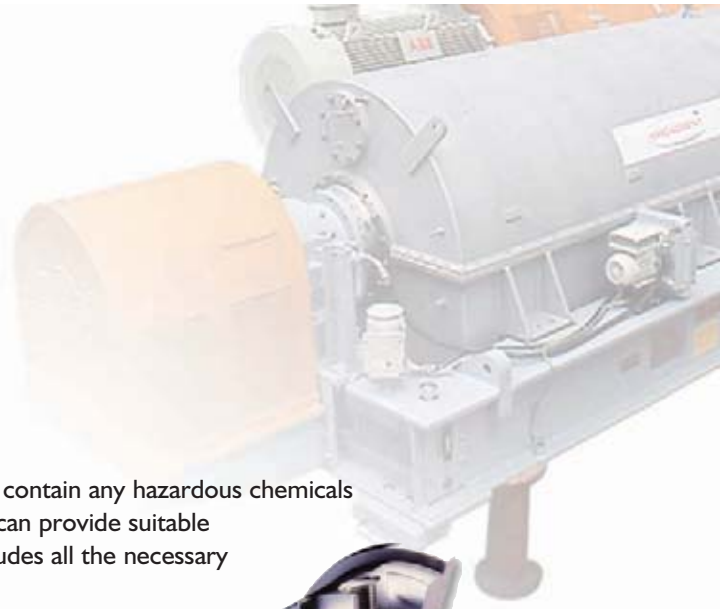
## Pressure Decanters

Broadbent have extensive experience in the design and long term operation of high pressure decanters. Cartridge sealing systems capable of maintaining a casing pressure of up to 10 barG are available on most sizes of Broadbent decanter. These systems use robust double faced mechanical seals and a seal panel to monitor operation and seal integrity.

## Drives & Controls

Broadbent decanter centrifuges offer the latest technology for energy efficient centrifuge drives and advanced PLC control. Options for the centrifuge drive system include :

- **ELECTRONIC VARIABLE SPEED DRIVE FOR THE MAIN MOTOR**
- **MOTOR & FLUID COUPLING WITH LOCK-UP AND DIRECT DRIVE AT FULL SPEED**
- **ELECTRONIC VARIABLE SPEED DRIVE FOR THE GEARBOX BACK-DRIVE MOTORS, IF FITTED**



## Advanced control PLC systems provide :

- **SAFETY INTERLOCKS AND CONDITION MONITORING**
- **LINKS TO PLANT DCS SYSTEM**
- **CUSTOMISATION TO MEET SPECIFIC SITE REQUIREMENTS**

## DECANTER OPTIONS (CONTINUED)

### Gearboxes: Fixed & Variable Speed

Broadbent produce a range of gearboxes designed and manufactured in-house specifically for decanters. These gearboxes are based on BS5346 and AGMA standards and have a variety of fixed ratios to allow optimisation of the decanter process performance.

In applications where process conditions change regularly a variable speed drive motor can be linked to the fixed ratio gearbox to provide a 'back drive' system whereby the conveying speed within the decanter can be continuously adjusted to optimise the process performance for varying feed conditions. Variable speed hydraulic gearboxes can also be offered if required.

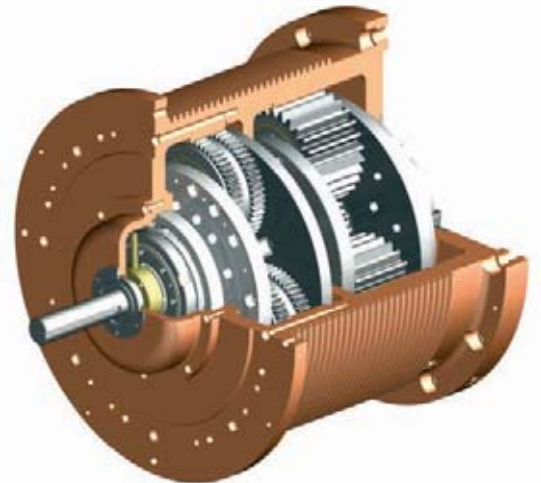


### Anti-Chatter Device (ACD)

In some applications (e.g. PVC and PTA) the nature of the material means slippage can occur during solids conveying leading to high frequency conveyor vibration and increased torque loading of the gearbox. To negate these effects, Broadbent has developed a range of proprietary "anti-chatter devices" which smooth out high torque, reduce the vibration and improve the decanter throughput and reliability.

### Abrasion Protection

An outstanding feature of Broadbent decanters is the possibility, if necessary, to clad the interior of the bowl and the conveyor blades with advanced wear resistant materials. This helps ensure decanter longevity in demanding applications where abrasion occurs. Severely abrasive applications on which Broadbent solid bowl and screen bowl decanters are in operation include coal, potash, calcium carbonate and oil-field duties.



In addition to stick applied and sprayed-on hard facing materials alternative technologically advanced wear resistant materials are also available. Options include :

- HIGH DENSITY ALUMINA CERAMIC
- SILICON CARBIDE
- SILICON NITRIDE
- TUNGSTEN CARBIDE



# DECANTER OPTIONS (CONTINUED)

## Washing

Washing features are available in both screen and solid bowl decanters. Recent patented development by Broadbent now allow decanters to wash more effectively extending the range of applications where washing in the decanter cake prior to discharge is viable.

## Chemical & Polymer Addition

In many effluent applications separation is enhanced by the use of polymers to flocculate the fine solids giving higher solids recovery and cleaner centrates. All decanters can be provided with facilities for chemical addition both external and internal to the decanter.



# LABORATORY TESTING & SITE TRIALS

The Laboratory provides a complete service to Customers considering centrifuges as a solution to their solid liquid separation problem.

## The Laboratory facilities include :

- CHARACTERISATION OF CUSTOMER SAMPLES.
- FULL PARTICLE SIZE & SHAPE ANALYSIS FACILITIES
- PURPOSE BUILT TEST AREA WITH FUME EXTRACTION BAY & ZONE 2 ELECTRICS.
- TESTING IS UNDERTAKEN IN-HOUSE OR AT THE END-USERS PLANT AS REQUIRED

The test centrifuges available from the Broadbent Laboratory for in-house or on-site testing include small scale batch basket centrifuges and a range of continuous centrifuges. A wide range of decanter centrifuges are available for trials :

- 150 MM SOLID BOWL - SEALED & N<sub>2</sub> PURGE.
- 150 MM SOLID BOWL
- 300 MM SOLID BOWL - SEALED AND N<sub>2</sub> PURGE.
- 450 MM SOLID BOWL
- 450 MM SCREEN BOWL
- 600 MM & 900 MM (SUBJECT TO AVAILABILITY)

The process Laboratory is a key resource enabling Broadbent to solve separation problems presented by Customers. It also enables the Company to undertake scale-up analysis to assess the implications of full plant operation with given products and processes. Please contact Broadbent to discuss your requirements.



**ONE COMPANY - MANY SKILLS**



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over 135 years of separation technology