Show centrifuge selection some consideration

Nigel Day, process development manager at Thomas Broadbent, explains the best way of selecting the right centrifuge for solids/liquids separation applications

When compared with alternative methods of solids/liquids separation, centrifugal processing provides a number of benefits but it is imperative that the most appropriate machine is selected for a specific duty. Doing this requires a thorough understanding of the various options.

Centrifuges can be installed in a relatively small footprint; have a high washing capability; produce low cake moisture; achieve a high capacity throughputs and can provide the user with a totally enclosed and contained vapour-tight processing facility. Centrifugal filtration is also considered to be one of the most effective methods of removing impurities.

Correct selection of a centrifuge is based on two key concerns: economic expectations and technical requirements.

Before considering the various options, it is essential to clearly define the process, and pass this information to the centrifuge supplier at initial briefings. This means the supplier can then base screening tests and feasibility studies on relevant data.

Once the process is clearly defined, it is easier to identify variables such as the percentage of suspended solids, volumetric slurries throughout, solids throughput and the required product consistency at discharge. Materials usually exit the centrifuge in a powdered or granular form, but there are some instances in which it can also be discharged as a paste. Product consistency will to some extent dictate the method of materials handling and transportation.

The prospective user should also clearly define exactly what the centrifugal process is required to achieve. Does the material require clarification, classification, degritting, thickening, dewatering, washing or separating and repulping, and is the process a solid-liquid, liquid-liquid or a three phase liquid-liquid-solid duty?

Other considerations include the expected 'G' force; allowable cake dryness; allowable solids in the discharge liquors; product temperature; viscosity; specific gravity; 

P ensures that the centrifuge is to be used within the pharmaceutical or fine chemical industry, it may have to be manufactured to a GMP design, with an integral CIP system.

The decision to use a batch or continuous machine can depend on many factors. Batch centrifuges have few limitations on the wash function, whilst continuous machines are mostly limited to a wash-solids ratio of approximately 10%, with no more than a few seconds allocated to the wash zone before completing the operation. If, for example, the materials to be processed have low residual impurities and a high washing requirement, the greater flexibility of the batch process will allow the necessary adjustment to satisfy individual needs such as extended washes and longer residence times.

Particle size, distribution and shape are also important factors when determining separation capabilities and whether or not a batch or continuous centrifuge is the best option. Generally, materials which are predominantly 45 microns and above and relatively incompatible are suitable for separation by filtration equipment, whereas finer or compactable materials lend themselves more to separation by sedimentation. Experience has shown that in some instances, material compositions can be suitable for both batch and continuous processing, irrespective of size or shape.

In circumstances where it is necessary to ensure that there is no cross-contamination between batches, machines can be installed with pre-programmable, validated clean-in-place (CIP) washing systems, which also eliminate the need to open the casing between cycles for cleaning and maintenance. These machines suit pharmaceutical and fine chemical applications.

Stringent codes of practice, influenced by recommendations of authorities such as the FDA - have created a need for validateable centrifuge designs, and have provided the initiative for the development of machines which combine good manufacturing practice (GMP) and PLC controls. These centrifuges are GAMP compliant with the ability to satisfy the requirements of process and environmental integrity. In situations where centrifuges are required to handle potentially explosive or flammable products, they can be installed with inert gas purging systems. Machines can also be supplied with pressure tight systems.

Having defined the process objective and required variables, specifiers can then select a specific type of centrifuge to meet their criteria.

Selecting the most appropriate centrifuge for the job requires a detailed understanding of the various options available as well as an accurate definition of the process.
If the requirement is for filtration (including drainage, cake washing or classification), a vertical basket, conical basket, peeler, pusher, screen scroll, screen bowl, inverting bag or vibratory centrifuge is suitable. Where the requirement is sedimentation (including separation, clarification, classification, degritting or thickening) - decanter, solid bowl basket, disk bowl and tubular centrifuges are appropriate. Preliminary screening tests will quickly indicate the best option.

**Centrifuge Types (Sedimenting)**

Horizontal solid bowl decanter centrifuges consist of two horizontal concentric rotating elements, the outer one of which is tapered so that solids discharge from a smaller radius than the liquor. Feed slurry is introduced into the conveyor hub by pump or gravity feed and delivered by centrifugal force into the rotating bowl via discharge ports, where solids settle through the liquor pool formed on the wall of the bowl.

There is a slight differential speed between the rotation of the bowl and that of the conveyor which takes the solids to discharge ports. The clarified liquor discharges continuously in the opposite direction from adjustable overflow ports. Employed as a classifier, the solid bowl decanter centrifuge effects sharp cuts of solids in liquor suspension, with materials as coarse as 50 micron, or as fine as one micron.

Solid bowl decanters are now favoured over batch perforated basket centrifuges mainly due to advances in conveyor design. There are exceptions to this where relatively small volume materials have to be processed, and cycle times are not a significant factor.

The disc bowl type centrifuge operates at high speeds of 3000 to 20,000 times gravity, providing a continuous clarification system which is suitable for use where materials have a solids content of less than 1 - 2 %. These centrifuges are designed to separate either a solid-liquid or two liquid phases on a continuous basis. The disc stack increases the effective settling/clarification area, and the liquid and solid phases travel up or down the disc surfaces. The liquid discharges through one or more paring discs.

Designed as a solid tube which is capped at both ends, the tubular centrifuge is usually fed through a bottom inlet with two liquids of different specific gravities. Of the two liquids, the heavier phase is concentrated against the wall of the cylinder, whilst the lighter phase floats against it. The two phases are separated by means of a baffle, which discharges them into two distinct flows.