The CINC centrifuge, is gaining market penetration as an alternative to conventional methods of two-phase liquid/liquid separation using gravity – a method which is slow, inefficient and offers poor process control. The CINC centrifuge offers a number of advantages over disk-stack centrifuges, separation columns, gravity-based decanters, coalescent or DAF type separators, mixer/settler systems and extractor systems.

WHAT IS IT?
The CINC technology was originally developed for use by the American nuclear industry. Ten years ago, the technology was engineered into a more general piece of industrial equipment and it was quickly identified as having a huge potential in the American pharmaceutical industry. By taking the initial concept of the patented separation technology, CINC engineers designed a user-friendly, small footprint, low-maintenance centrifuge with few moving parts. The simple design of the centrifuge offers major benefits over the older design of disk-stack models. The separation occurs due to the differences in specific gravity between the two immiscible liquids and quickly establishes a real-time separation, discharging clean phases accordingly.

Such is the versatility of the CINC technology that it can be used for simple separations, extractions, water washes and reactions. It has a variety of options that allows the unit to act as a mixer contactor for extractions and water washes, or a reduced mixing option for separations. The centrifuge is designed in such a way that multi-staging of units can easily be incorporated, converting an existing manual system (using mixer/settler tanks or columns on a batch basis) into a continuous process; this option offers a greatly improved process for multi-stage extractions.

The CINC discharge outlets are situated above the inlets; consequently, multi-stage units can be gravity-fed into each other without the need for pumps. Units can be arranged to offer a counter-current flow, thus reducing the levels of water and solvent required.

HOW DOES IT WORK?
There are a number of options for feeding the unit by the use of one- or two-feed inlets, depending on the application. Aqueous and/or organic streams can be fed individually or together under controlled flow rates by gravity or low pump pressure. If separation of two liquids is required, only one inlet is utilised. The mixed phase enters the unit and drops to the bottom zone, where it is directed to the rotor inlet, after which a mild pumping action and additional flow feed the turning rotor. The rotor spins at a pre-determined speed, subjecting the liquids to a centrifugal G force.

OPTIMISATION OF SEPARATION
Separation optimisation is achieved by pre-testing the process in a small-scale laboratory model. The results achieved are easily applied to production-size machines and so expensive production-scale machines can be purchased with the confidence of confirmed test data.

Optimisation is determined by a combination of three variables:
1) Flow rate into the unit will determine fluid residence time in the rotor, which is particularly relevant if the specific gravities of the liquids are close together; liquids with a specific gravity difference of 0.02 have been successfully separated.
2) Motor speed (and therefore rotor speed) determines the G force required to achieve the separation. G forces of between 100 and 1,000 are achievable at the rotor wall and are particularly beneficial to break difficult emulsions. A variable frequency drive enables the motor speed to be set at different levels.
3) Weir size – the units are provided with an assortment of heavy phase weirs. The most suitable weir is selected to accommodate the specific gravities of the two immiscible liquids to be separated. A computer-generated matrix is available to determine in advance the most suitable weir.
TECHNICAL SPECIFICATIONS AND DEVELOPMENTS

Since the introduction of the first machines, CINC design engineers have been quick to respond to field experiences in order to incorporate engineering improvements to enhance the technology. Improved options include a 'take-apart' rotor which allows easy dismantling and cleaning of the rotor system if there are solids present in the liquid. This is also an essential option if the technology is to be used on 'multi-products' when clinical-standard cleaning is required.

New bottom-bearing and seal systems have been introduced; these include a removable combined bearing and seal system held in place by four cap screws. Should there be a bearing-failure or seal-leakage, the whole cassette can be replaced within minutes, so down-time is kept to an absolute minimum. Since the introduction and successful implementation of the new lower bearing system, demands from the US nuclear industry have required removal of the bottom-bearing and seal-assembly altogether as a specific option. This resulted in the rotor being suspended by two bearings in an enhanced upper bearing housing.

CINC’s ability to design and offer so many options has greatly enhanced the product range and has options to suit customer requirements. Five units are now available in the range, with a nomenclature based on the rotor size of each unit. Design capacities are from the laboratory test unit (the V2) at 1.9 L/m to the largest (the V20) with a capacity of 757 L/m.

The standard material of construction is stainless steel 316; however, alternative hastelloy materials and a variety of internal special finishes to FDA standards are available. Full traceability of materials and certificates of conformity to FDA standards can be supplied to specific requirements.

Risk assessments have been completed to accompany ATEX requirements for explosive environments. Nitrogen-purging and the use of vibration and heat sensors, together with an appropriate variable frequency drive controlling the maximum speed on the motor, all ensure sufficient protection to meet ATEX, CE and noise legislation.

Since its introduction, the technology has proved itself to be simple to operate, reliable and easy to maintain, with low installation and operating costs. Significant paybacks and savings have been achieved by improvements in manufacturing processes, resulting in improved yields, less waste, higher quality, reduced waste-water costs, less solvent use, greater solvent recovery, lower manpower costs – and the option to design a continuous process.

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