

### Continuous Extraction



- Beverages
- Biochemicals
- Foods
- Pharmaceuticals

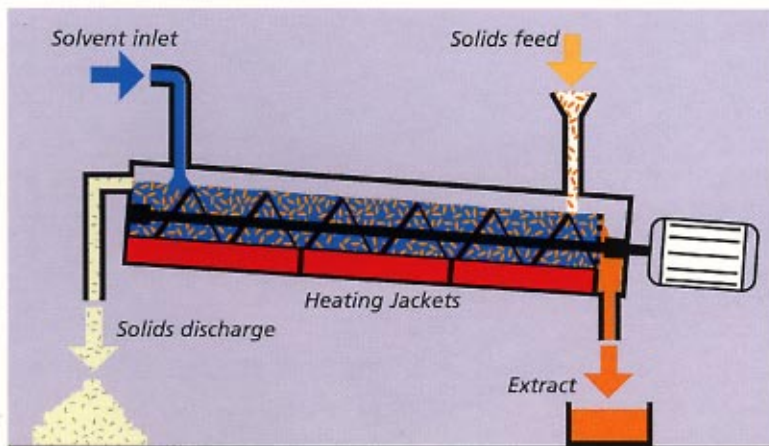




## Continuous Extraction

The continuous extraction process has been a focus of a dedicated research and development programme by Niro over many years enabling the process to be successfully applied to a variety of products in the beverage, biochemical, food and pharmaceutical industries.

With Niro's technology it is possible to achieve quality extracts at the highest yields enabling further economical liquid processing of the extract or conversion to powders by spray drying.



### Typical Product Applications

- barley
- camomile
- chicory/coffee substitutes
- coffee
- frangula
- ginger
- ginseng
- health foods
- hibiscus
- natural medicines/herbs
- rye
- tea

### Available Plant Sizes

Six standard sizes of volume:  
27 - 180 - 300 - 830 - 1400 - 2750 litre

The throughput of each standard size depends upon the product application.

## The Niro Continuous Extraction Unit

The Niro extraction unit operates on the counter-current extraction principle featuring an inclined trough surrounded by heat transfer jackets for temperature control of the process. The raw material (solids) enters the lower end of the trough and is transported upwards by two helicoidal conveyors. The solids are therefore transported in a gentle spiral movement which gives ideal counter-current plug flow extraction conditions. As the solids pass through the extractor, each particle is subjected to the same extraction conditions.

The extraction liquid, normally water, but organic solvents are also applicable, enters at the highest point of the trough and flows under gravity percolating downwards through the upward moving solids. The slope of the tilted trough can be adjusted to accommodate the liquid flow rate. The resulting extract drains from the base of the trough, while the spent solids are discharged from the top end. Novel self-cleaning filters are incorporated to eliminate product losses and maintain extract purity.

The continuous counter-current extractor is characterized by ability to achieve:

- high yields of extractable material
- high solids contents in the extract
- uniform and controllable residence time for efficient extraction
- easy scale-up from low to large capacity units
- low operating costs by minimizing cleaning time requirements and maintenance costs



## Achieving Quality Extracts

### Importance of Residence Time of the Solids Phase

The residence time of particles in the solid phase is controlled by the speed of the helicoidal conveyors.

The graph shows the typical residence time distributions of the solids phase. The actual plug flow curve indicates the very high degree of solids plug flow that is achieved in the continuous extractor.

### Importance of Plug Flow in the Liquid Phase

The plug flow characteristics of the liquid phase gives a most favourable concentration profile utilizing the counter-current operation to the full. Since the concentration of extract is low where the solids phase leaves the extractor and high at the point of solids feed, the amount of extraction liquid necessary is minimized while maintaining high extraction yields.

Conditions close to ideal extraction liquid flow patterns occur within the extractor. The inclination of the extractor is set according to the products in order to maintain the correct flow of extraction liquid through the solids. The residence time of a liquid phase is an important factor regarding extract quality.

### Importance of Process Temperature Control

Optimizing an extraction process also requires optimum temperature conditions. A very precise temperature profile throughout the extractor is achieved by the heating jackets supplied with heating and cooling medium as required by the process.

### Pressurized Continuous Extraction

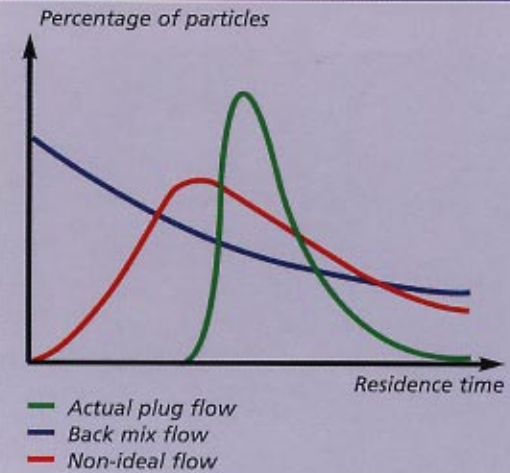
The Niro continuous counter-current extraction unit is also available for operation under pressure enabling the unit to be used for chemical solid/liquid reactions such as hydrolysis. These units are designed to pressure vessel codes. Although the solids now have to be fed through a pressurized hopper, the feed into the unit remains continuous. Operation under pressure allows extraction temperatures to exceed the atmospheric boiling point of the extracting liquid.

Special designs are also available for extracting solids with organic extraction liquids.

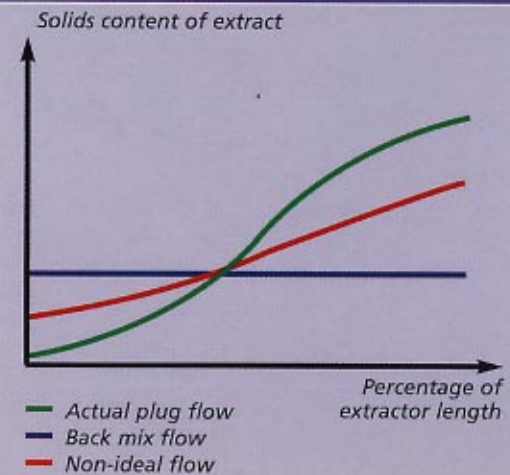
### Pilot Plant Facilities

A 27 litre pilot plant is available for customer test work. Although Niro has much experience with the operation of the continuous extractor on an industrial scale, pilot plants are often recommended as part of the extraction process and are considered essential where new product applications are involved.

### Residence time of solids phase



### Plug flow of the liquid phase



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