Increasing effective yield of frying meat products

There are big differences between direct and indirect fryers, especially where it concerns the effective yield of breaded products. Indirect heated fryer systems can provide a competitive edge in production performance, including product quality and cost advantages.

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Simply put, we fry food because it tastes good. However, there are other basic objectives that we are looking for in the frying process:

- Frying enhances the appearance of the product through colour development and surface texture.
- Many of the coatings that are applied to a product for flavour, mouth feel, colour and texture need to be set-up by flash frying after application.
- A delicate product or coating can be made more robust to better endure subsequent freezing, transportation and storage.

Traditional technology in breaded product frying can fulfil the above basic objectives, but often falls short of satisfying those objectives that can provide a competitive edge in both product quality and cost competitiveness – they cannot deliver the same *effective yield*.

Effective yield

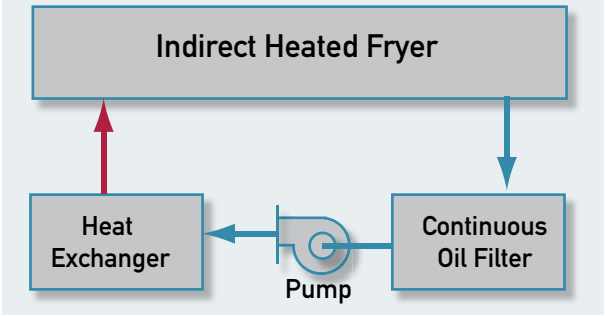
In terms of cooking systems, yield is usually used as a measure of the weight change during the preparation and cooking process. By widening this term to include other causes of profit erosion, a more informative production performance measure can be obtained. This is referred to as 'effective yield'. Some of the issues that play a part in effective yield are: system oil volume, oil degradation, filtration quality, product quality, and downtime. There are two different types of fryer systems available, namely direct heated fryers and indirect heated fryers. Direct fryers are those in which the cooking oil is heated by an internal source in the fryer pan. Indirect fryers, on the other hand, are those in which the cooking oil is heated by a source external to the fryer pan.

Product and oil quality

Due to the need to have heating elements built into direct fryers, the pans of direct heated fryers are always deeper than the equivalent capacity of indirect fryers, and therefore hold more

GENERAL CHARACTERISTICS OF DIRECT AND INDIRECT FRYERS	
Direct Fryers	Indirect Fryers
Still oil bath	Continuous oil circulation
By-pass filtration only	Full flow filtration
Total system oil volume is filtered between 1 and 4 times an hour	Total oil volume in system is filtered approx. every 60 seconds
Fast temperature response	Fast temperature response
Size of the fryer governs heat input	Fryer is sized on the space required to cook the product
Fines removal is difficult	Fines are kept in suspension for ease of removal by filtration
Straightforward installation requirements	Modular design makes installation straightforward
Large system oil volumes due to pan depth	5-50% less system oil volume

INDIRECT HEATED FRYING DIAGRAM



oil. This has an adverse effect on both product and oil quality. An additional complication of this effect results from the frequent need to base the size of a fryer for a particular product and capacity not on the space required to cook the product, but on the size of the heating elements to achieve sufficient heat transfer. This may result in fryers up to 25% longer than an equivalent indirect fryer, which, in turn, further increases the total oil volume.

Better flavour and smell

In most frying operations the free fatty acid level of the cooking oil will rise to an unacceptable level if the total volume of oil in the system cannot be turned over within 7-8 hours. Turnover occurs by the pick-up of oil into the products as they pass through the fryer. This oil is then replenished with fresh oil. Many breaded and meat- or fish-based products do not have a very high rate of oil pick-up. In order to achieve an acceptable turnover time, it is critical that the volume of oil in the system be kept as low as possible.
An indirect fryer typically has approx. 25-50% less system oil volume than the equivalent capacity of the direct fryer. This substantially lowers oil turnover times and helps keep free fatty acids at acceptable levels.
In terms of outcomes, this means that products cooked in an indirect fryer may have better flavour and smell, as well as longer shelf-life. To achieve equivalent results using a direct fryer, it may be necessary for the processor to discard oil from the fryer and replace it with fresh oil. This, however, dramatically increases the operating costs of the fryer.

Low oil film temperature

When using a hot gas to oil heat exchange, the cooking oil film temperature is approx. 15°C above that of the cooking temperature set point. Due to the heat transfer factors involved, the film temperature in a thermal fluid to cooking oil heat exchange is likely to be somewhat higher than this. With a liquid to liquid heat exchange the temperature of the heat exchanger tube will be close to the average temperature of the two liquids, whilst in gas to liquid exchange the tube temperature will be much closer to that of the liquid.

Less carbon build-up

In terms of outcomes, this means that the cooking oil will suffer less thermal degradation and will discolour less quickly, smoke less and reduce the amount of carbon build-up in the fryer. Once again, this will reduce the need to prematurely discard cooking oil from the fryer. Naturally, this improvement is only obtained when using a direct fired heat exchanger. Indirect fryers with indirect fired heat exchangers, such as external thermal fluid heat exchangers, will see the same film temperatures as direct fryers with internal thermal fluid heat exchangers.

Improved oil life

In an indirect fryer fitted with full-flow primary filtration, the entire system's oil is passed through the primary filter about every 60 seconds. Due to this oil circulation, fines are many times more likely to remain in suspension in the fryer until removed by the filter. In comparison, a direct fryer with by-pass filtration passes the oil through a filter typically between one and four times an hour.
A micro-fine secondary filter is often installed on indirect fryers processing those products that produce very small fine particles. To prevent any possible build-up of these charred fines and the risk of oil degradation, all system oil is circulated through the secondary filter at least four times per hour. The outcomes of this filtration are the almost total elimination of black particles (burnt fines) on the finished product, reduced carbon build-up, discoloration and smoke, a well as improved oil life.

Gentle product handling

When a coated product first enters a fryer, the coating is most fragile and

at risk of damage. In a direct fryer the product must be moved through the still oil at the same constant rate regardless of its position in the fryer. This requires the product to push through the oil, risking coating wash-off and being moved against other products.
In an indirect fryer with Heat and Control's Gentle-Flow™ multiple oil inlet system, the oil flow at the inlet end of the fryer can be adjusted to closely match the product transport speed. This ensures minimum relative movement between oil and product during this fragile stage, avoiding washing off of the coating and forcing products into each other. Extra opportunity to maintain product orientation is achieved from this combination of matched oil and transport velocities and the small oil depth. Very soon after entering it begins to set and become less vulnerable. Oil flow can then be increased.

Easier to clean

Generally, an indirect fryer is easier to clean - and keep clean - than a direct fryer of similar throughput capacity. Firstly, the fryer itself contains only the product conveying system. There is no heat exchanger, sediment conveyor or sediment removal system to contend with. Drapes on the underside of the main conveyor belt also continually sweep the pan clean during operation, moving any sediment to the fryer oil outlets. The conveying system is lifted from the pan by the motorised screw jacks to allow pan cleaning after processing is complete. A full Clean-in-Place (CIP) system allows controlled sanitation between shifts or as required. The CIP process cleans the entire pan and conveying system, stacks, hood, heat exchanger, circulation and filter systems, and because there is less surface to clean, the cycle time and sanitation manpower level can both be reduced. PPM