

# Making your frying oil last the distance

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**F**rying oil can be an expensive part of food processing and any steps the processor can use to reduce loss or wastage of oil can only result in greater business profitability. There is no single method for optimising oil life but rather it should be addressed comprehensively as many areas influence oil integrity. Some of these areas include the selection of the most suitable oil, effective fryer design, oil meeting established specification, oil storage and handling and effective frying procedures.

What is the best oil for the job?

The selection of the most suitable oil for your needs is nearly always a compromise of areas such as availability, market acceptance, processing needs, product characteristics, environmental needs, machinery suitability and the cost of the final article. All these areas and possibly others need to be considered during the selection process of this important food processing ingredient.

Traditionally saturated fats/oils have delivered a relatively stable frying process but as markets increasingly embrace the use of unsaturated oils in their foods, these unsaturated oils can also increase problems with the frying process and ultimately the final product. These problems can lead to reduced product shelf life, increased oil wastage and

rapidly increased processing costs and market losses. To offset these new oil challenges, the effective use of fryers and their systems takes on a greater importance and the processor should take all steps to use these systems to their optimum capability.

When the processor decides what oil type they require, the next step is to establish the minimum standard of oil that will be accepted and then have it formalised into a comprehensive oil specification. A limited specification can result in receiving oil that meets the guidelines yet has varying characteristics. This will affect the end product because the specification does not take into consideration all the oil attributes that influence the frying process. Effective HACCP systems should identify the hazards associated with frying and the end product and from that the oil specification should be developed by the processor as part of their HACCP system's preventative measures.

Good Handling and Storage Practices

Oil quality attributes initially come from suitable raw stock material and these attributes should be maintained at a specified and acceptable level through the refining process up-to and including oil delivery. Anywhere along this process chain, the oil can be corrupted and so the processor should always ensure that the oil

being delivered actually does meet the agreed specified limits. This level of raw material monitoring/testing is usually dependent upon the processors confidence level.

During bulk oil delivery, the truck should be designed for oil cartage and be clean both inside and outside for minimising possible contamination issues. During the transfer of oil to the bulk tank system, the operator should ensure that the oil is not aerated; paying particular attention to when the tanker oil level is near empty. The oil storage tanks should also be covered and constructed with non reacting materials, e.g. Stainless Steel. The tank should have a central drainage point and ideally the oil draw point should be above the lowest point of the tank to minimise any settled particles being drawn into the fryer system. Ideally the storage tank may have some form of modified head space atmosphere (e.g. Nitrogen) to help preserve the oil against oxidation. The tank and associated pipe-work should be cleaned on a basis as determined by the processor.

Some oils can go solid, such as Palmolein Oil, in order to keep them liquid the oil tank and its associated pipe-work should have some form of heating built into them to keep the oil from solidifying. In tropical environments this may not be so important but in many situations this contingency needs to be considered.

Can I make my oil stronger?

Within frying oils are compounds called anti-oxidants which help strengthen the oil against oxidation. The level of anti-oxidants can vary with different types of oils and may vary with

each oil shipment. Within a certain range, the higher the level of anti-oxidants present in the oil, the stronger the oil is against oxidation. Natural anti-oxidants (e.g. Tocopherols) are the best form and are normally present in oils, but some suppliers add artificial anti-oxidants to help strengthen their oils. A growing practice in the oil processing industry is the use of natural anti-oxidants such as Rosemary extract as a further supplement to the frying oil. On the other hand the use of artificial anti-oxidants are sometimes used (e.g. BTHQ) but these are regulated by certain countries plus consumers appear to be growing in their reluctance in the use of additives in the foods they eat.

Some other beneficial oil additives are chelating agents which strengthen the oil but should be strictly dosed at the specified requirements. Other types of oil additives commonly used in frying are a type that form a very thin layer on top of the oil so protecting the oil from the Oxygen within the air and as a result, delay the onset of oil oxidation.

The use of these added anti-oxidants and other additives depends on market, processing and regulatory needs and can be different for most situations. Accordingly the processor should investigate carefully any additives used in their frying situation.

How does oil spoil?

There are several ways oil breaks down but three main areas tend to stand out;

### 1. Oxidation

When frying oil in the presence of oxygen, it may undergo oxidation and form hydro peroxides. This reaction increases substantially with temperature, generally the hotter the oil the greater the chance of oxidation development. The peroxides that are developed are unstable and at frying temperatures they will breakdown to form an array of secondary oxidation products. Some of these secondary products may develop pleasant fried tastes and odours while others give rise to unpleasant, acrid odours and off flavours leading to rancid product.

### 2. Hydrolysis

This reaction is generally caused by water reacting with the oil molecule and causing part of the molecule (fatty acid) to detach. After the fatty acid is broken off from the oil molecule this new detached part is called a free fatty acid. This detaching reaction can increase in the presence of various scenarios such as the presence of acids, high oil temperatures, low oil turnover rate, increasing the number of heating and cooling cycles, etc. FFA's increase the acidity of the oil and as this increases it may cause the fried product to have a tainted or acidic flavour.

### 3. Oxidative Polymerisation

This reaction leads to gummy deposits on frying equipment and a greasy appearance on the fried products. During frying, the major type of polymerisation occurring is "oxidative polymerisation".



*A comprehensive approach to oil management will positively influence the final product.*

### The Right Equipment

There are a lot of different types of frying systems available; from batch fryers through to industrial continuous fryers, directly heated fryers vs. in-direct heated systems. The right system is always dependent upon requirements and available resources.

When you select the frying system these are some questions that should be asked:

- *How do I heat the oil?*
- *Will the machine affect oil selection?*
- *Does the machine deliver the required product?*
- *What is the systems production capacity?*
- *How efficient is it?*
- *What are its operating costs?*
- *How much space will the system occupy?*
- *Ease of maintenance and cleaning?*
- *What level of filtration do I need?*
- *What is the machine's rate of return for these assets?*

Well designed frying systems address a variety of needs including maintaining oil integrity. Some examples of these pro-active functions are:

**a) Modified atmosphere**

To help retard oil breakdown the frying oil should be minimally exposed to air. This is done by various methods (e.g. steam blanketing, internal baffles, controlled air flows, etc.). Each technique is designed to prevent oil oxidation, the process of oxygen within air interacting with the oil.

**b) Correct oil levels**

Larger industrial frying systems have sub-systems to ensure the oil level within the fryer is set to the optimum level. Too much or too little oil within the fryer system can damage the oil as well as increase costs.

**c) Fryer system sizing**

The fryer should be sized to suit the heat load from the required production capacity. If the fryer is too big for the actual production rate then the “oil turnover rate” may be too great causing oil to breakdown too severely before it can be replaced by fresh oil. If the heater is sized too small then it cannot supply sufficient heat and again production rate has to be reduced and so causing the related oil problems.

**d) Correct fryer materials**

The fryer system should be manufactured from functional materials that will not compromise oil integrity. An example of incompatible materials in a frying situation is copper or any of its alloys.

**e) Ease of cleaning**

All frying systems should be relatively easy to clean. In some larger frying systems C.I.P. (Clean In Place) systems are integrated into the fryer for effective and semi-automated cleaning.

**f) Draining**

All good frying systems should be designed so that any water or cleaning fluids completely drain out of the system. The removal of water from a fryer system is critical for oil integrity also for user safety.

**g) Filtration**

The fryer system should have an effective filtration system to remove the particulate material from the fryer. The product attribute may dictate what type of filtration system(s) are required which could include cartridge filters through to continuous belt types.



*Effective filters remove particles from the oil*

## Effective Frying Techniques

Here are some tips to help maintain oil quality:

### **Start as late as possible**

Fill and start heating the fryer system only when production is about to begin. Pumping and heating oil without cooking any food not only damages the oil but results in additional operating costs.

### **Keep the fryer closed**

Keep the fryer closed as much as possible to keep the protecting modified atmosphere (e.g. steam) within the fryer. At the same time this inhibits the ingress of fresh air into the fryer. The machine operator should not lift the fryer hood or its openings as the machine will quickly lose this protective atmosphere.

### **Match or exceed design production rates**

The processor should always have the frying operation at least at the designed production rate. If they can continually produce at a higher rate and still deliver a good product than it is expected to help with oil integrity. Further it should also make for greater productivity levels and the associated cost savings.

### **Fresh oil may need older oil**

Fresh oil does not have the flavour characteristics that are developed during the frying process and some processors purposely age their oil when starting with a clean fryer. They may "bruise or condition" the oil by heating it without product or simply put some older oil in with the fresh oil to get this fried flavour in to the product when they start production. After commencement they revert to using fresh oil thereby allowing these flavour characteristics to develop in the oil but at a controlled rate.

### **Cool and Store as soon as possible**

After production or during extended production stoppages, the oil should be cooled to below 100°C as quickly as possible and then stored in the appropriate storage areas. HC