

## Replacing Conventional Bag Filtration With 3M™ DF Series Filters In Edible Oil Processing

### Introduction

Edible oils are generally derived from various oilseed sources including sunflower, soy bean, corn, peanut, rapeseed, and other vegetable sources. Crude (unrefined) oils may contain a variety of naturally occurring substances that are considered undesirable since they may have a negative effect on the final properties of the oil (taste, odor, color, stability). These substances, including proteins, free fatty acids, and phosphatides, are reduced through a series of mechanical and chemical processing steps (refer to edible oil process schematic in Figure 1 on the next page).

Some of these process steps, such as bleaching, hydrogenation, and deodorization, can generate unwanted particles that must be reduced to maintain the quality of the oil. Many edible oil processes employ conventional filter bags to perform this operation. While being relatively inexpensive in terms of “per-filter” cost, bag filters are known to have a number of drawbacks that increase the true cost of bag filtration. These drawbacks can include: limited contaminant holding capacity that can result in frequent filter change-outs, a cumbersome design making installation and reduction difficult at times, and variable retention performance that can affect the quality of the oil.

3M Purification Inc. developed the 3M™ DF series filter system to address these concerns. The unique element design easily retrofits existing bag filter housings, providing substantial operating benefits without the cost of purchasing new filter housings. These benefits include:

- 62% more surface area to provide up to four times the service life of conventional bags
- Advanced media construction that leads to consistent filtrate quality
- Easy-to-use design allowing for more secure sealing and effortless installation and removal



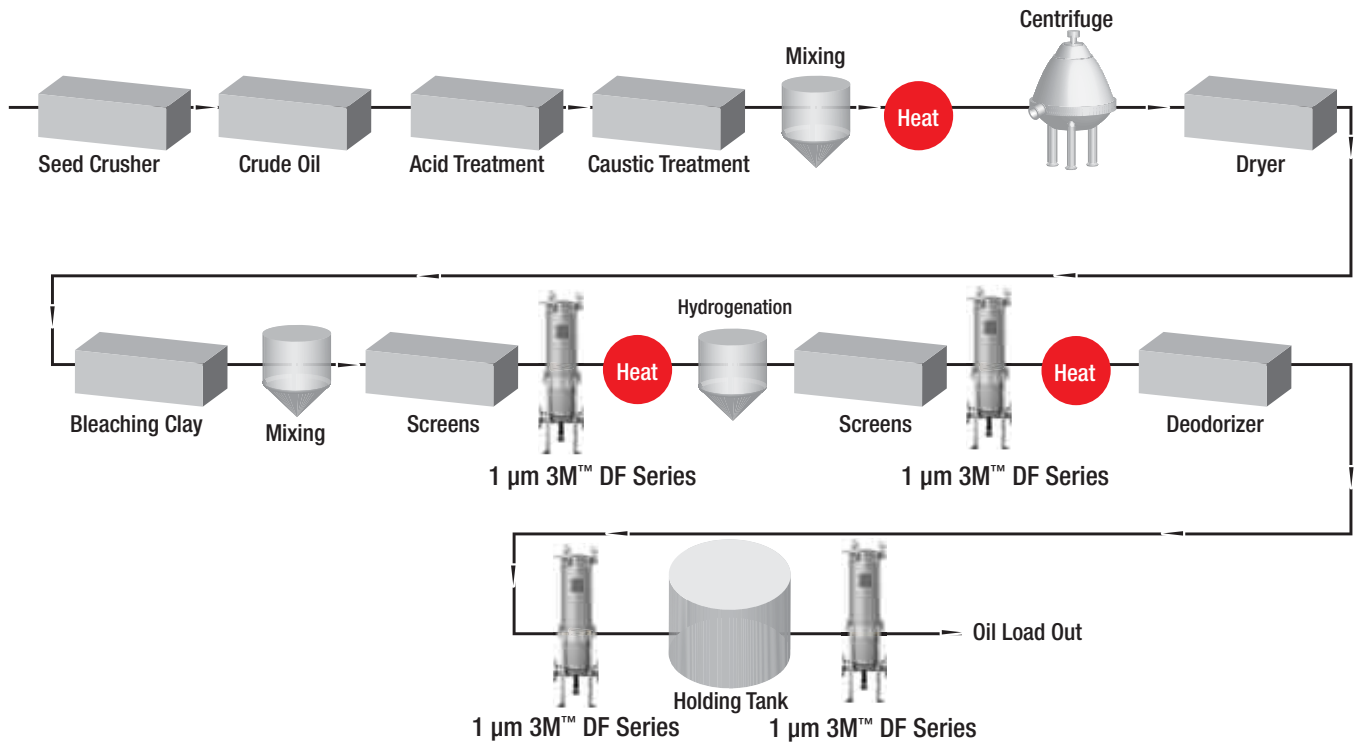


Figure 1. – Edible Oil Production - General Process Schematic

## Edible Oil Process

While edible oil processing methods can vary according to the source of the oil and other factors, the schematic above is intended to serve as a guide to points of filtration commonly found in these processes.

## Problems Associated with Conventional Filter Bags

### *Frequent Filter Bag Change-out*

Filter bags often need to be changed frequently due to their limited holding capacity. Change-out frequency varies depending on the application and the solids loading, however, it is not unheard of to change bags as often as 2 to 4 times a day. The reason behind this frequent change-out rate is that the two-dimensional nature of the common filter bag limits the amount of filtration surface area available to trap solids.

### *Cumbersome Installation and Removal*

The thin, flexible design of many common filter bags can often make them difficult to install correctly. Ensuring the bag is hanging vertically, and without twists or kinks can be a chore. Sealing the bag in the housing can also be difficult, adding to potential bypass around the seal and poor filtration. During operation, as the bag becomes loaded with contaminants, the soft filter media can be extruded in to the flow holes in the support basket, making removal difficult. Lastly, upon removal from the filter housing, the unsupported design of a bag filter, loaded with trapped solids, has the potential to break (as many a long-time user of filter bags can attest), allowing contaminants into the clean side of the filter housing.

### *Variable Performance*

Since many bags are essentially two dimensional, thin and pliable “screens”, it is not uncommon for them to release previously captured particles as differential pressure builds across the filter during normal operation. As particles are retained on the filter media, differential pressure builds and forces fibers to shift and flex, disturbing the particles and allowing them to pass through the filter. This process is called unloading and can be exacerbated by any changes in pressure or flow in the system.

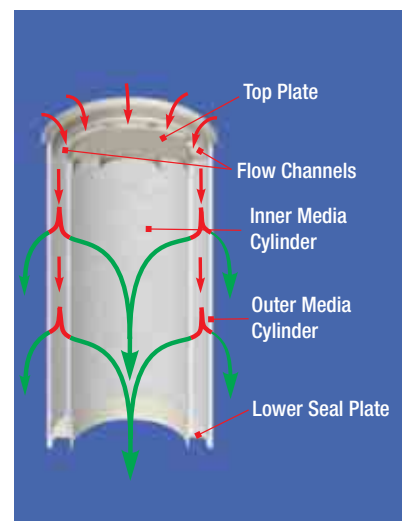


Figure 2. – 3M™ DF Series Filter Element Design Showing Flow Path

Some design features of common bag filters can also make them more susceptible to particle release. Many bag seams are sealed by a stitching operation that results in small needle holes. These holes can allow particles to pass through the filter. Additionally, many bag filters have a flat, collar like seal at the top, or neck, of the bag. In housings that have been in operation for a number of years, this seal may become compromised, again allowing bypass of unfiltered oil around the bag filter.

The result of poor filter bag performance can include:

- Bleach-clay or catalyst bleed through
- Heat-exchanger fouling
- Frequent pump maintenance
- Out-of specification oil requiring reprocessing

## **The Solution**

3M™ DF series filter system is an advanced alternative to standard bag filters. 3M Purification developed the 3M DF series system based on the needs of the edible oil industry, as well as other bag filter users, specifically to address the deficiencies many users have noted with bag filters.

The 3M DF series system easily retrofits most existing filter bag housings. The filter system consists of a rigid filter element and a reusable support basket. (Refer to Figure 2.) The 3M DF series filter element itself is comprised of two cylinders of filter media, a smaller filter media cylinder contained within a larger filter media cylinder. The filter media cylinders are thermally bonded to the top plate, which contains a series of flow channels, and at the bottom plate.

Fluid flows into the filter at the top through the flow channels in the top plate. Once inside the filter, fluid then flows through either the filter media of the inner cylinder or the outer cylinder, leaving particles and other undesired contaminants trapped in the filter. Once the clean fluid has passed through the filter media, it is collected in the clean chamber of the housing. This unique inner cylinder design results in a significant increase in filter media surface area, the benefits of which are detailed below.

### ***Greater Filter Media Surface Area Results in Greater Service Life***

The unique 3M DF series design results in up to a 62% increase in filter media surface area compared to common #1 and #2 filter bag housings. This is achieved by the optimized dual-cylinder design of the 3M DF series filter media that traps particles on either cylinder surface during filtration. This dramatic increase in surface area is beneficial in a number of ways. 3M DF series filters can last up to four times the life of a conventional filter bag. This extended service life also means that manufacturing down-time to change the filter bags is reduced as is the associated labor. Additionally, since fewer 3M DF series filters are required for a process, the amount of disposal is also reduced, further lowering filtration costs.

The greater surface area of the 3M DF series design also provides a lower initial pressure drop at the same flow rate when replacing similarly rated bag filters. This lower pressure drop can translate into benefits in one of two ways. Keeping the process flow rate constant, 3M DF series filters have a lower pressure drop than comparable bags filters, resulting in longer service life (since filters are typically replaced when they reach a set increase of differential pressure). A second benefit is that at a given process differential pressure, the flow rate of a 3M DF series filter will be greater than that of a bag filter. This allows the user to increase their system flow rate without adding additional filter housings.

### ***Advanced Filter Construction Leads to Consistent Filtrate Quality***

The 3M DF series filter media and element design feature a number of innovations that result in more consistent performance when compared to conventional bag filters. These include:

- A novel “singled” filter media surface that prohibits fiber release
- An advanced thermal side seam, reducing the threaded seam common in bag filters
- A superior sealing collar and lip that creates a dynamic spring-like seal with the housing
- Multi-zone, graded-porosity filter media that selectively traps larger particles in the outer layer and smaller particles on the inner layer
- An integral filter media/top plate that employs state-of-the-art ultrasonic welding techniques for a superior seal and greater element integrity

### ***Easier Filter Change-out***

Unlike the thin, flexible, two-dimensional nature of bag filters that can make them difficult to install and remove at times, the 3M DF series filter element is a rigid, three dimensional cylinder. The filter element easily slides into the support basket, and the support basket

into the existing bag filter housing, providing excellent support and ease of installation and removal. To remove the element, simply insert the removal tool into the top plate and lift the filter from the housing.

## Conclusion

3M developed the 3M™ DF series filter system to address the concerns expressed by edible oil manufactures regarding the performance of conventional bag filters. The unique cartridge design easily retrofits existing bag filter housings, providing substantial operating benefits without the cost of purchasing new filter housings. These benefits include:

- 62% more surface area to provide up to four times the service life of conventional bags
- Advanced media construction that leads to consistent filtrate quality
- Easy-to-use design allowing for more secure sealing and effortless installation and removal

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