



FILTERING THROUGH THE NEWS No. 14

Date: 09-09-2015-rev 3

Attn.:

To whom it may concern

BIO DIESEL; FILTER SELECTION AND PROCESS CONDITIONS

With reference to the many questions and previous discussions on this subject we have pleasure to submit our info in more detail.

PMI filtration specialists have been involved in many discussions on the subject of filtration of G/S= Glucoside /Sterols from bio-diesel and how to select the correct filter(s)for the application. In this write up I will try to summarize our findings and please accept my apologies for the fact that I did not mention all the other filter aid brands available on the market.

For bleached oil application and other process sections where filtration is of importance a special write up is available.

BIO DIESEL:

We have entered the arena of bio-diesel applications several years ago and the majority of our filters can be found in:

- Crude oil filtration after expeller presses in both cold pressed oils and hot pressed oils in pre-press and full-press applications
- Bleaching or Pre-treatment. The preparation step for filtration of clay/ filter aid Silica / adsorbent.
- Removal of polyethylene from rendered animal fats and tallow.
- Filtration of adsorbents when dry method with adsorbent purification is used and no water wash is practiced. (Adsorbent like magnesium silicate, silica or equivalent).





- Pre-coat filtration of bio-diesel from rape (Canola), soybean, palm, (sunflower) Oils and animal fats to remove “sterols/glucosides ” and other haze in order to Obtain clear oil that meets ASTM D-6751 and EN 14214-sedimentation test or standard filter plug test. This filtration is performed using filter aids such as kieselguhr (Eagle pitcher FW 14), Perlite (Dicalite) and or FILTRACEL EFC (JRS cellulose materials.)



Since the initial oil used for bio-diesel in Europe was mainly rapeseed there was initially no concern on the haze in the oil after production and water wash with centrifugal separation was sufficient. In a later stage and with the introduction of sunflower seed oil it became necessary to winterize the oil first and with soybean oil (and rape/palm oil) it became necessary to clean the bio-diesel from any visible haze not removed by the centrifuge and here pre-coat filters have been introduced.

The standard set in the USA is that the incoming turbidity is < 0,05% solids/insoluble (including moisture) while our filtration has been stable with no more than 0,010% solids/insoluble (excl. moisture) in the filtered bio-diesel. In real life we found up to 100-ppm incoming turbidity but this is still considered low.

In Europe we comply with the required 24 mg/liter (or less up to 20 ppm and currently even 10 ppm max) total solids in the final methyl ester product. In a later stage animal fats such as rendered fats, yellow grease, tallow, used cooking oils are also used in multi feed stock applications and the haze in these products is mainly to be defined as phosphorus and/or mono glycerides and require other steps to ensure removal of polar components resulting in a clean and haze free product.

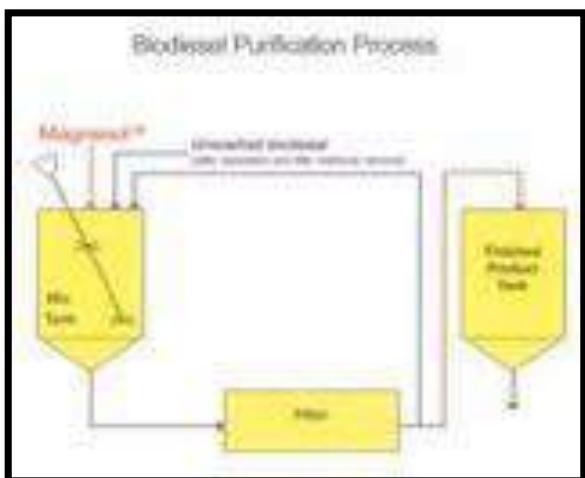
The more recent development shows in the direction of full compliance with new standards referred to as “DETERMINATION OF FILTER BLOCKING TENDENCY (FBT) ”.

Since the sterols are not easy to handle and behave like waxes/gums on the filter septum we prefer to use pre-coat leaf filters operated with body feed as per incoming turbidity and this proven technology has been accepted by most production plants and engineering companies. NOTE: Trisyl Silica, Dallas Magnesium silicate, Oildri Select clay and Tonsil BIOSIL



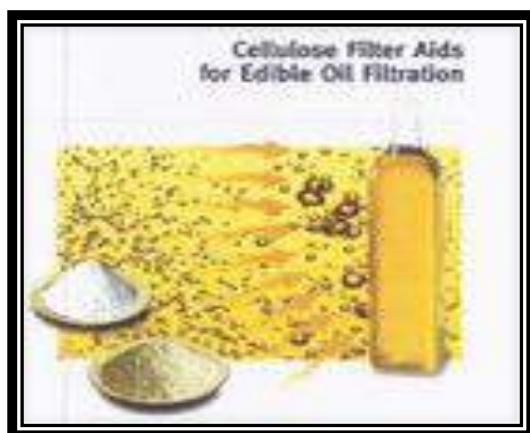
are all adsorbents also used in the process of bio diesel final filtration but the use can be expensive.

For the pre-treatment /dry washing filters we supply either the standard bleaching filters as used in the bleaching process of edible/vegetable oils or we supply PLV vertical tank, vertical leaf type filters for the removal of MAGNASOL, TRISYL silica/clay, SELECT clay or Tonsil SSN since only soap, gums, oxidation products, metals etc. have to be removed and not color. Silica filtration might require some pre-coat with kieselguhr/Perlite or Cellulose before it can be filtered but high flow rates (350-500 kg/m²/hr.) are standard seen.



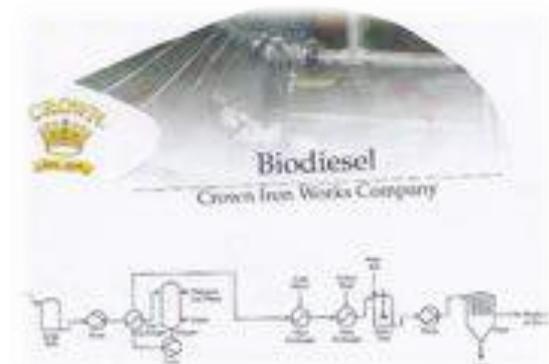
If the discussion is about using disposable element filters (bag or cartridge) the insoluble (solids) or Sterol / glucosides (SG) should be low i.e. less than 20 ppm and we recommend you to use polishing filters with disposable cartridges or bags. The standard procedure is to filter SG with pre-coat filters to ensure a maximum solids content of < 20 ppm in the filtered methyl ester. We are aware of the fact that in some plants the SG are removed with centrifuges but we also know that these can't in all cases ensure

the required 24 mg/l (24 ppm total contamination) or the more recent norm of < 15 ppm. The common method practiced is the use of a pre-coat leaf filter as described above that filters the methyl ester at low temperature (approx. 5 °C above the cloud point of the oil) after a certain holding time and using some body feed (0,05% to 0,1%).





Note: The actual holding time can vary from only <1 hr. where the formation of SG is triggered in the presence of filter aid as seeding material to 12 hr. maturation as indicated and recommended by some of the engineering companies. We would recommend to contact your supplier of the technology/plant and ask them for the correct cooling/maturation time.



We will continue with a short summary of the conditions for final filtration of sterols from rapeseed oil (RME), Soy (SME) and Palm (PME) or alternative tallow/animal fat and used cooking fat. We assume that you are familiar with the filtration of bleached pre-treated feed stocks using silica (Trisyl by WR Grace) or clay (Sud-chemie or Oil Dri products). Both the PLV (dry cake discharge) and the PLH RB (dry cake discharge) type filters in both carbon steel and stainless steel 1.4301/AISI304 construction are used with filter leaves in 1.4404/AISI 316L.

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The common method practiced is the use of a pre-coat leaf filter that filters the methyl ester (FAME) at low temperature (approx. 5 °C above the cloud point of the oil) after a certain holding time and using some body feed 0,05% to 0,1% (in your case max 0,05%). After this filtration and before tank filling there is a bag type filter using disposable filter bags as safety/police filters using 5-10 micron filter bags.





O-ring seals PTFE encapsulated to be resistant in methyl ester process. In some cases the bag filter is replaced by a disposable cartridge filter but only if a very low contamination has to be removed (i.e. <25 ppm).

Where a single bag filter with 0,5 sum has a dirt holding capacity of not more than 300 grams dry solids, the disposable wound cartridge has only room for 100 grams solids (dry), in the best case, per 10 inch cartridge (10 inch is 0,05 sum).

The methyl ester is hygroscopic and will attract water, which will require the use of coalesces after storage to remove the water from the methyl ester.

Both disposable bag and cartridge filters should be used only when the incoming solids level is very low and traces have to be removed. The disposable element is not only costly to purchase, it will also contain product (loss) and it will represent a waste problem.

We will continue with our general info:

Introduction

- Filtration temperature 20 °C (or lower like 7-10 °C). Depending on the type of oil We recommend 5 °C above cloud point. (For rape/soybean oil we recommend 7 °C And palm oil approx. 20 °C)
- Filter aid for pre-coat (PC) and body feed (BF) allowed
- Pre-coat with clean bio-diesel.
- Dry cake discharge
- Solids concentration and crystallization of sterols is temperature dependent.
- Filtrate quality visual clear without any remaining solids even after 48 hr. at 5°C

Pre-coat formation

Filter aid is added in the desired amount to a filtered volume in the pre coat tank (0,5 kg-1 kg per m² filter area. The pre-coat slurry is re-circulated and filtered in order to form a pre-coat layer on the filter. (Use EP type FW 14,JRS Cellulose, Dicalite 4128 or equivalent). Pre-coat should be performed with clean filtered bio-diesel.

Body feed slurry preparation

Filter aid is added in the desired amount to unfiltered feed to the filter. Body feed in the range of 0,05-0,1% W/W or max 0,3% in special cases. (Use EP type FW 14, JRS cellulose or equivalent)



Filtration conditions

The filter and feed should be restricted / tempered at 7-20 °C. In general approx. 5 °C above the cloud point. (Palm oil 18-20 °C)

Special attention should be given to good homogeneous mixing of the body feed with the bio-diesel feed.

Results

- Visual clarity can easily be obtained using a pre-coat (and body feed) of Diatomite filter aid FW 14,JRS Filtracel, Dicalite 4128 or equivalent on 80 Micron wire mesh screen.
- The filterability with 0.05-0,1% body feed is estimated from the tests and historical data; an average flow of 750 kg/m²/hr. during 16 hr. or 600-650 kg/m²/hr. during 24 hr. was calculated . This 600 kg/m²/hr. at 20 °C should be used for sizing.

NOTE; at approx. 7-10 °C the viscosity changes and some people want to work at this low temp. level. Flow rate to use is then 400-500 kg/m²/hr.

Animal fats might require lower flow rates and higher filter aid dosage and/or silica adsorbent might be required but this should be checked and tested.

- The addition of BF in the range of 0.05-0.1% (max 0,3%) body feed will influence the filterability; more body feed will increase the average flow or extend the filtration time but the maximum cake thickness is the limiting factor. An optimization of BF addition versus average flow and filtration time should follow under production circumstances.
- The cake after drying with AIR/N² is dry (25-30 % residual liquid) and discharged easily.

Recent tests on a 30% PME/70% RME methyl ester (from a Belgian producer) have shown that after 10 hr. cooling at 18 °C we reduced the total contamination level from incoming 42 ppm to < 11 ppm and the incoming S/G content of 39 ppm was reduced to less than 11 ppm too. At clients in Frankfurt and Gent a mixture of Palm and rape methyl ester the same results are met.



In winter conditions and below 7°C we see that the stearin in the palm oil solidifies but after heating it up to 20 °C and keep it for several days the haze i.e. SG does not re-appear. We know some engineering companies and process designers do not install filters in their process design but in several cases they have been forced to install filters afterwards in order to meet the guarantee and cold flow-plugging test.

In all the plants we supplied filters to and where palm oil (PME) is the feed stock (Malaysia, Germany, Belgium, Brazil, Spain, etc.) we have not seen any problems with the final PME and total contamination was <24 ppm with no info that the CFPP or FBT did not pass. The use of palm oil is very much dictated by the price.

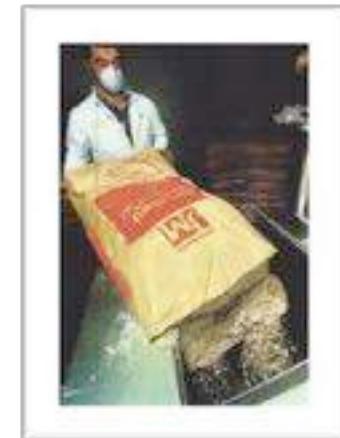
FILTER AID (PRE-COAT AND BODY FEED):

In order to know and select pumps and pre-coat material it is essential to also know the differences between the various filter aid on the market.

There are basically three most used types i.e. ;

A) KIESELGUHR (Diatomaceous earth);

DE = fossil plant/animal available in different grades and inert. Has been under suspicion of being carcinogenic but in the past 2 years this has been reversed and it is only recommended to work in dust free environment. Biggest supplier is CELITE (JM)under the name Celite and well known grades are HYFLO SUPERCEL, CELITE 545, 577, FILTER CEL and others. Alternative brands are EAGLE PITCHER (FW 40,60,80 etc.). Material is like sand thus abrasive.



B) PERLITE= volcanic glass like structure available in different grades and inert. Was favored at the time that DE was under carcinogenic suspicion but is lighter and more difficult to mix into the solution (more floaters). PERLITE = CHEAPEST.



Material is lighter and cheaper. Most famous name is DICALTE and grades are 4128, 428,etc. The 8 indicate that it is from Belgium and when a 6 is used the origin is USA. material is abrasive.



C) CELLULOSE. This is the more recent promoted material. In the past very often the kieselguhr or Perlite was mixed with cellulose to form a dense pre-coat layer / blanket. In more recent years the Solka Flok and Alfa Cel was replaced by Rettenmaier FILTRACEL. The advantage of the cellulose is the fact that it is bio-degradable and it can be incinerated with very little ash (both DE and Perlite are inert , can't be burned and have high ash after incineration). Material is not abrasive.

Our recommendation is always to ensure that the system is universal and can be used with either one of the filter aids mentioned. Kieselguhr and Perlite are very abrasive and I would recommend using a centrifugal pre-coat pump with open impeller and 1450(2900) rpm to go gentle on the abrasion.

REMOVAL OF MONO-GLYCERIDES:

Very often a polar filter aid /bleaching clays and/or silica (silicate) are used to remove Phosphatides, soaps, oxidation products , metal compounds , etc. Mono glycerides however can't be removed by filtration. In normal cases 0,6-0,4 % is acceptable but with an industry that requests even <0,2% it will be required to give extra reaction time or even consider the expensive distillation.

If requested we can submit info for the various filter aids and bio-diesel requirements and hope this will answer your questions. Whatever is selected , our recommendation to our clients is to make the system universal so all three filter aid materials can be used depending on availability and preference /price.

In terms of yield the best filter aid is no or if required very little filter aid

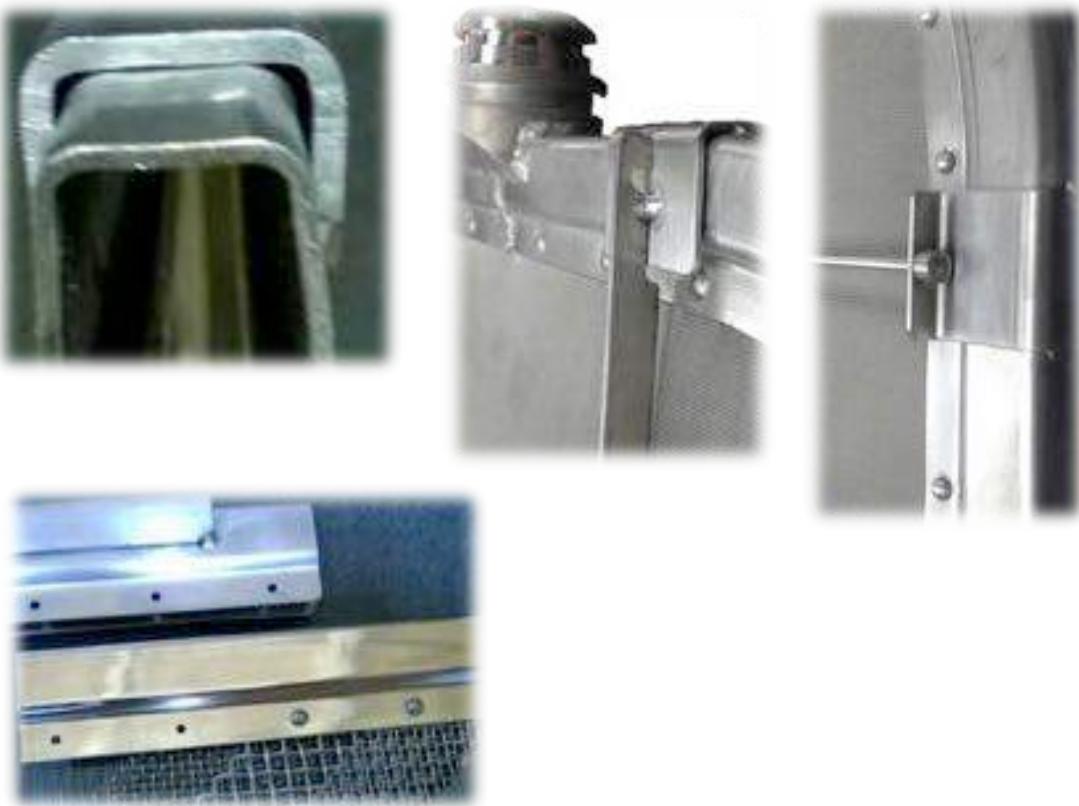


CORNER REINFORCEMENT AND CAKE BREAKER BARS.

Improved design and reinforcement of the leaves;

Some minor technical improvements have huge effects on the performance of the filter and the durability of the leaves.

Just to mention a few we want you to consider leaf corner reinforcements, special filter screen, leaves with breaker bars, manifold with cake deflection plates between the leaves, etc.



Detailed information and filter specific write up's on all these filtration steps are available on request.

We hope that this will assist in the much wanted and required overall improvement and in case of any questions please call our service and support centre

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One of our manufacturing plants in Ipoh, Malaysia

PMI offers a wide range of products, which include:

- Filter Presses, Pressure Leaf Filters, Reverse Pulse Filter, Cartridge Filters, Bag Filters, Nutsch Filters, Centri Filters, Tilting Filters, Level Leaf Filters, Agitators, Static Mixers.
- Pressure Vessels, Tanks and Silos, Columns, Towers, Dryers, Shell & Tube Heat Exchangers, Condensors, Heaters, Coolers, Reboilers, and General Steel & Stainless Steel Fabrication & Site Erection Works.



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