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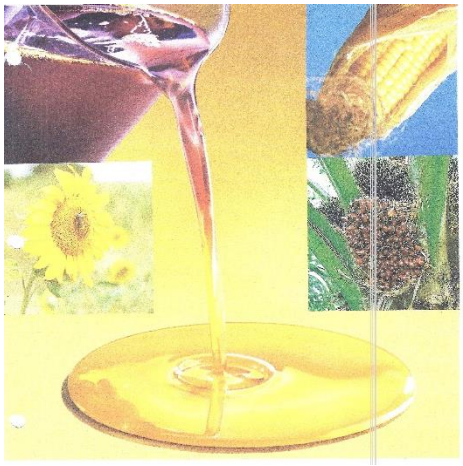
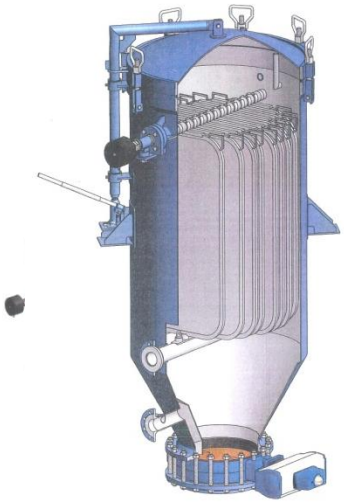


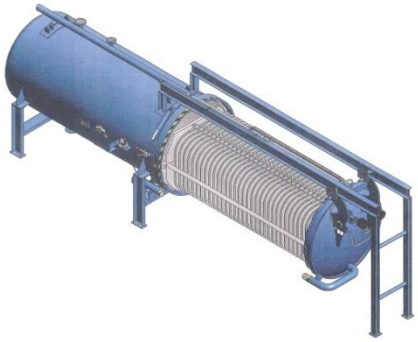
FILTERING THROUGH THE NEWS No. 25

Date : rev 4.0(02-2016)

Attn :To whom it may concern.

RECENT DEVELOPMENTS IN BLEACHED OIL FILTRATION

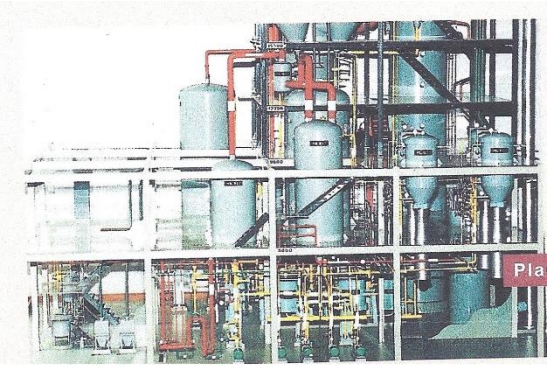




Even when we consider the many write up's I made for the various processing steps there is still a whole range of people that only want to be on the latest page in respect to the filtration of bleached edible / vegetable, animal and fish oils. On the more special applications our write up's are already available and a short list is:

- Crude oil filtration after expeller presses in both pre-press and full-press applications.
- Miscella filtration (lecithin)
- Detox or AC filtration.
- Hydrogenated oil filtration.
- Sterol/Glucosides Filtration in bio-diesel process
- Winterised oil filtration.(both full conventional winterising and polish winterising after centrifugal dewaxing)
- Fractionation. etc

BLEACHING:



Bleaching is one of the steps all refiners have to consider and only once in my life I found a sunflower seed oil refinery where the sunflower seed oil was only refined (caustic) and then deodorised (=Deso) after which it was bottled . It needs no further explanation that the oil was not a high quality product and was packed in tin cans of 5 litre so nobody could see what was in it.

The bleaching of oil is one of the process steps that I consider ripe for the next level. Until now most bleaching is performed after refining (Chemical or Physical)and depending on the type of oil or the plant design in combination with the location and the preferred process either one of the two refining methods is selected. Only exceptions like cottonseed oil miscella refining are the exception to the rule and what the future will bring we don't know.

The search of non-chemical processing opened a world of opportunity and challenges . Years ago it started with the soft degumming but at that time no one could predict that we would use enzymes for degumming. The next step could be enzymatic bleaching but in this paper we stick to the more conventional bleaching methods.

It is right now that we see a revival of the caustic or chemical processing . Issues like 3MCPD in palm oil and environmental issues like the amount of waste water have made people to look at the "old" or "new" refining method . On top of the mentioned advantages the refining will also result in a better product but at what price ?

In this paper I will not promote one of the refining methods but merely write about the effects they have on bleaching and the bleached oil filter performance.

It has been accepted that caustic or chemical refined oil should be filtered with max 0,1% H2O, 25 ppm max soap and max 5 ppm P. In Physical refined oil max P should not exceed 25 PPM. In real life we see soap levels of 100 ppm or more and P varies from 5 to 40 ppm. In filterability this has big effects and even more in the frequency of leaves being washed i.e. high pressure cleaned outside the filter vessel. The use of silica/ clay in the so called "dry degumming" where leaf filters take over from historically used centrifuges will be handled in a separate paper.

PROCESS FILTER INFO:

Caustic refined , 25 ppm soap and 5-10 ppm P filtration rate is 280-300 kg/ sqm/hr and leaf clean/wash frequency every 12-24 weeks.

Physical refined , 2 5 ppm P filtration rate is 250-280 kg/ sqm/hr and leaf clean/wash frequency every 8-12 weeks.

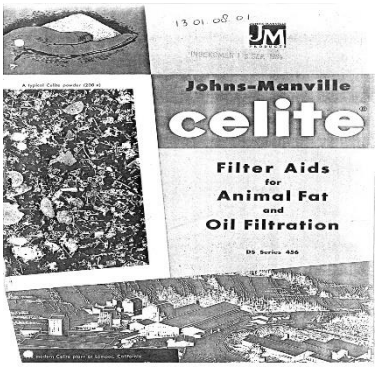
When P goes up wash frequency goes up and In cases where we have > 25 PPM P we see cases where up to every 2 weeks a leaf wash is required.

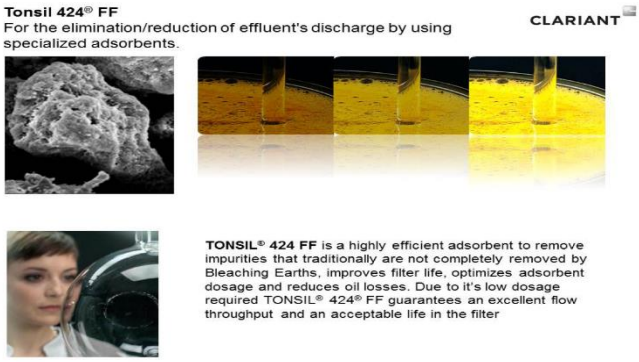
After the oil is refined and before any further processing the oil needs to be bleached. In case the oil will be also winterised (before deso)we will in this paper not discuss the advantages or disadvantages of where we filter the winterised oil . It can be mentioned however that most refiners are still very affright to deodorise first and filter the winterised oil after the Deso. The temperature of winterising (2-12 degC) will ensure only minimal rise of the peroxide level and it could have great influence on the utilities like steam and E cost.

The most practised process is refining (60-70 degrC), bleaching (80-110 degrC), winterising (2-6 degrC) followed by Deso (210-240 degrC) before it goes to storage at < 20 degrC . This will require a good heat exchange between bleaching to winterising and again with Deso. When energy becomes a more important issue this will become interesting but with the current situation not many are willing to take the lead.
A very interesting development is the change of landscape from a multi feed stock application world into a more and more specialized single feed stock world. Life has to a certain extend become more easy for the plant super intendants . A more prominent role to play are the logistics now. Argentina with soy extraction plants and refineries with up to 3000 mt oil per day. Brazil with sunflower seed oil refineries of up to 1500 mt/day and palm oil with more than 3000 mt oil per day all have changed the refinery landscape and made the implementation of new or improved processing methods easy.
On the other hand we still have to consider the multi feeds stock plants and the consumer wish for gourmet oils.
Already in other write up's I mentioned the use of adsorbents and filter aids and a short statement will bring you up to date;

"In all cases it should be remembered that when a filter type and supplier is chosen it should be avoided that the use of a specific clay, adsorbent , filter aid or filter results in a dedicated design that makes the use of other products not possible".

We differentiate between adsorbents and filter aids.
Filter aids are;
DE = Diatomatheous earth (=fossil ,kieselguhr) by Celite Corp or equivalent.
PERLITE= (volcanic glass like structure) by Dicalite Corp or equivalent.
CELLULOSE= (wood pulp) by Rettenmeyer Corp or equivalent.



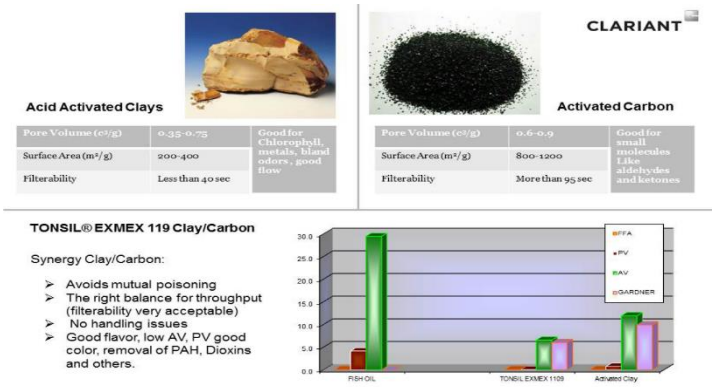


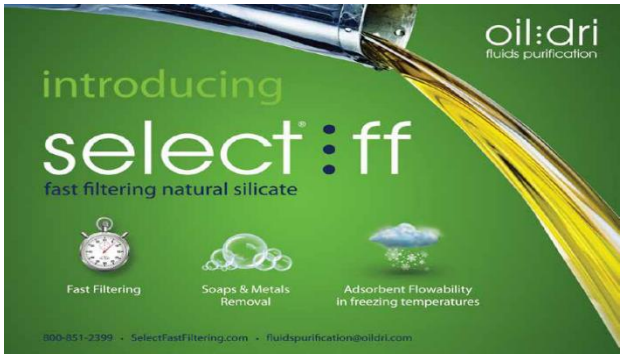
Adsorbents are:

- Montmorillonite or Attapulgite = Bleaching earth .

Brand names;

Clariant (was Sudchemie) type Tonsil 424 Optimum FF= fast filtration.
BASF (was FILTROL) grade 105 SF =speed filtration.
And others.





- SILICATE

Oldri type SELECT FF = fast filtration.

- SILICA .

TRiSYl by WR GRACE ..

- ACTIVATED CARBON

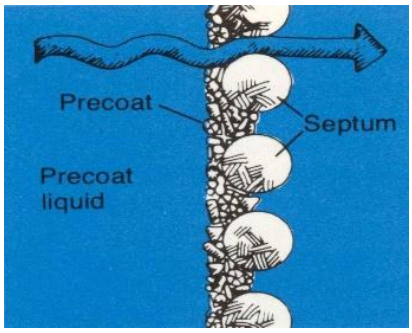
CHABOT (was Norit AC activated carbon).type SA4-PAH-HF = high filtration

Whatever screen is chosen it will only be the support medium for the filter cake we are going to build. The solids (BE or/and FA) Will be re-circulated over the filter to build a thin layer of filter cake (0,5-1 kg/sqm)in which the actual filtration takes place. When the application requires a continuous dosage of filter aid during the entire cycle we call this body feed. The body feed will keep the cake open and will give enough porosity so that the maximum quantity of suspended solids can be retained before the septum becomes blocked, when the septum is blocked cleaning becomes necessary which in turn causes an interruption inflow.

This is common practice in winterised oil filtration but not in bleached oil filtration. Most bleaching clays will act as a body feed and are made with excellent filtration characteristics. The confusion created by some suppliers about the absorptive capabilities of some filter aids should be treated with care. We have come across the statement that if a filer aid (DE or Cellulose) is positively charged (Zeta + or acid activation) it would give absorptive strength and could be used in bleaching. The same has been tried with silica and the fact that some large refiners have tested this extensively with no result tell us to be careful. (Cuno has tried with filter pad's called Zeta+ to get similar results in the 70ties and failed)
In bleaching the amount of clay (solids & filter aid) is at the end of the day important since it will be called waste . The amount of oil in the cake is important and any addition to the cake will be synonymous for additional loss. If we follow the report by the late Barry Morton (†) who was realistic in the residual oil contend in spend clays. We can all understand that 25-30 % rest oil in 1000 kg spend clay cake is more that the same 25-30 % rest oil in only 750 kg spend clay cake. For those plants where the spend cake can be send to the extraction meal the oil content is less important since a certain amount of oil in the meal is required anyway.
Legislation however has forbidden the addition of spend clay to the meal so the amount of waste gets more and more important.

THE INFLUENCE OF THE CHOOSEN FILTER SCREEN:

In our "filtering through the news" no. 15 (screen selection How&Why) and no. 16 (filter leaves with 60 mesh twilled weave and breaker bars) we give more info on the actual selection of the filter screen and here we will highlight the critical points to consider when selecting a screen for bleached oil filtration.
At this stage it is important to mention that not the screen will filter but the initial layer of clay or filer aid / pre-coat is the actual filtration septum. The screen is only the support for this first layer of solids but it pays a very important roll.



Pre-coat or cake filtration

The refiners nightmare is to have found the most optimal (=most selective and active) bleaching clay to find out it will not filter properly (to fine ??). I know that some people want you to believe that when we add filter aid we can filter all oils but at what cost.??
We have always been looking for the most economical solution and have been innovative in offering the industry various options. We have no preference for any clay or filter aid . Whatever is chosen should however work on the leaf filters and the correct screen choice is essential.
The most common screen was the 24 x110 DUTCH WEAVE filter screen but through other industries we discovered the PZ 80 S Panzer screen . The retention went from 120 micron to only 80 micron in a screen that had the same or better mechanical characteristics.
The std 60 mesh screen as used in crude oil filtration to handle the fibrous foots in the oil had a 0,19 mm wire and 240 micron nominal retention. This screen was not only weak it also had a retention that made the use of filter aid/ pre-coat material a must.

This did put us in a predicament because we are certainly not against the use of filter aid but in terms of cost and yield (not mention operator work load and quality issues) we want to avoid or at least minimize the use of filter aid where possible.
With the choice of 60 mesh plain weave that choice can't be made anymore and pre-coat filter aid is a must. The clay would on a 240 micron screen go right true.
The PZ 80 is a smooth screen and will filter even very fine clays direct i.e. without the use of filter aid. When we use a filter aid like cellulose on this PZ80S the fibre would entangle into the screen and cake discharge becomes more difficult. The old 24 x 110 Dutch weave is a possible alternative but the 60 mesh twilled weave with 0,26 mm wire and 150 micron retention was the perfect choice. It will work well on direct filtration of clay because the retention is small enough , it is strong wit 0,26 mm wire and it is woven in such a way that it will not entangle cellulose or any other fibre from a filter aid / pre-coat .

If we have to mention one advantage of using filter aid we have to say that the use of a pre-coat (0,5 to 1 kg dry filter aid per square meter filter area) prevents the screen from being in contact with the clay and possible gluey or slimy solids in the bleached oil (P ,hydroxides and soap). This will make the vibration driven cake discharge easier and fouling of the leaves and subsequent washing them clean can be done less frequent.
It is our goal however to offer the industry the most optimal filter design and most economical solution.

MATERIAL CHOICE:

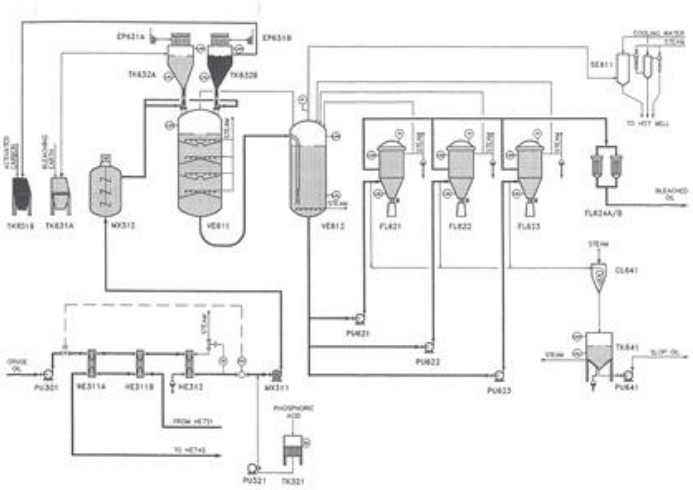
In the processing of bleached oils it is important to know the refinery and the refining process. In physical refining process the correct material choice is essential. With the presence of some access acid from the acid pre-treatment, the use of acid activated clay, and the presence of a weak acid at high temperature vapour lock above the leaves in the dished cover part of the filter vessel make that we have to consider the very corrosive environment in this process. Another point of interest should be the leaf cleaning method .

The most common design is a tank (rectangular or round) where the leaves are positioned vertical on a manifold , completely submerged in the caustic soda solution (10-15 % strength) and under agitation and bubbling of the solution at 50-70 degrC for 3hr+. The leaves are boiled to soften and remove the solids build up in the screen and inside the leaf. When ready with the caustic boiling the caustic needs to be neutralised before the liquid is dumped. The neutralising is done with citric or phosphoric acid and again this has to be done with care because if the leaves are exposed to over dosage of acid the weak acid at high temperature will have a devastating effect on the outer screen and eventually on the entire leaf. After this "boiling ?"process it is important to rinse and high pressure clean the leaves with water to ensure that all remains of caustic and acid are washed away.

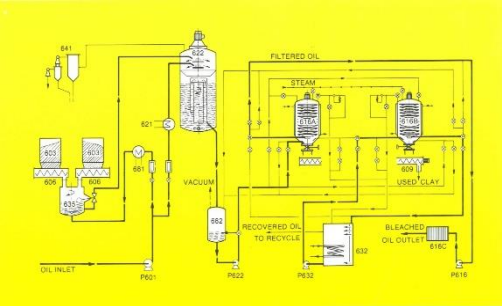
It is for this reason that our filter elements ,for any bleaching filter, are always made in material AISI 316L(1.4404) but the actual filter screen can be offered in a special alloy NSCD or 316S which is a 904L alloy(1.4539) with high Cr,Ni,Mo and some copper.

This material has proven to be resistant against the conditions where a std 1.4404/316L is not.
The bleaching section of the refinery is in most cases carbon steel and so is the filter vessel. Over the years we have been able to convince more and more people to use at least a stainless steel AISI 304 cover disc for the vessel. Clients in the palm oil refining business have however started to buy full stainless vessels(Felda, IOI, Cargill, etc).

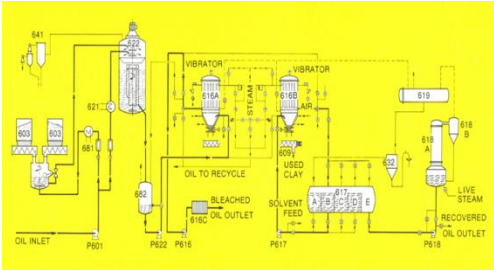
CHOICE IN BLEACHING SYSTEMS:



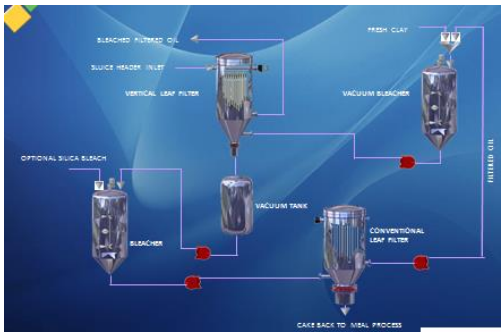
In all the years that I have been active in the design , manufacture and implementation of leaf type filters in the bleaching process of edible, vegetable , animal and fish oils there was a continuous quest for improved performance, more capacity i.e. bigger filters , but above all higher yield.
Already in the early stages of oil bleaching like at Hercules filtration in 1939 the first publications can be seen about the industries wish to safe on clay and to lower the clay consumption or get better yield from the clays.
Refining and removal of those ingredients that where the cause of the high clay consumption where the first improvements and with the improved designs of the centrifuges used in refining big steps where made.
The relation between the presence of Phosphatides, soap ,FFA , sulphur , oxidation products, moisture ,etc and the bleaching and filter performance cleared the way for better clays and we saw acid activated clays become the std.
The addition of water in the initial stages of the leaching process was a major breakthrough (late 70ties by Werner Zschau ,Sud-Chemie).
Removal of rest oil from the clay was the next move and we saw “Thompson Washing” i.e. after completion of the filter cycle the cake was washed by hot water and this resulted in 10-12 % residual oil but it was messy and expensive to run.



The change from water wash to solvent extracted filter cakes was eminent and Unilever promoted this in their plants. The volatile hexane however wand the fact that the filters had to be placed in the ex-proof plant section made the system to complicated despite the fact that only 3% residual oil was found in the spend clay.

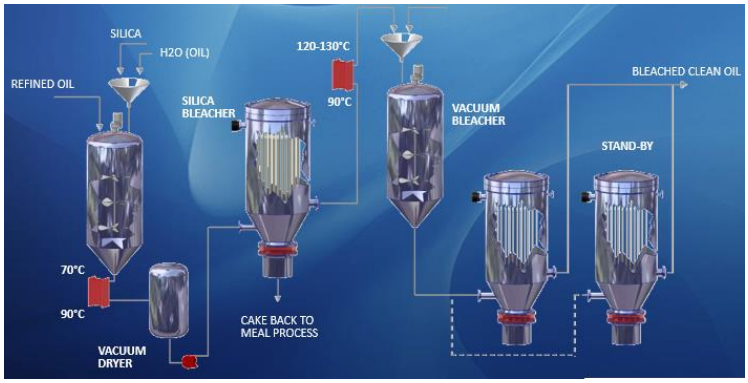


It was the tallow /soap industry that had to deal with poor feedstocks and they discovered that if we could use the clay more efficient like 2 or 3 time we could benefit from the fact that after one time use there was still 40 -50 % residual bleaching strength left in the clay. In reality however it was quickly discovered that if we shifted the clay loaded filter to the feed of the bleacher we only had very short filtration times because the “dirt” that we wanted to remove like P, soap ,oxidation products ,etc resulted in almost instant blockage of the clay layer. At that stage we did not know that this would become the most efficient way to work however with improved adsorbents and different rule’s .



Mr Gunter Boerner of Oehmi (Now B&B Magdeburg Germany) came out with his state of the art COUNTER CURRENT BLEACH process. It is another variation on the more efficient use of bleaching clay. The secret in this process is the avoidance of any contact between the used clay with air or moisture before it is reintroduced in a second bleacher. This way the oil sees the clay twice and up to 40 % clay reduction in high consuming oils like coconut, palm and rape where seen . The higher the original consumption was the more could be saved.

The company WR Grace by Mr Massoud Jalalpoor was next in the row. This producer of silica as used by the brewing industry to stabilize beer started the promotion of silica under the name of “Trisyl”. Initially silica was added to the conventional clay but at later stages the best results were obtained when the feed stock first where TRISYL bleached under atmospheric conditions at no more than 70 DegrC . In this step the majority of P , Soap. Oxidation products ,etc where reduced and the oil on the way to the conventional bleacher was send to an already formed clay layer with clay from that conventional bleacher. This layer stopped all the pollutants that where the reason for a high clay dosage and the bleacher only had to bleach on colour and metal compounds. The final DESO took care of the colour anyway.



The system became known under the name TRI-CLEAR (WR Grace), COMBI CLEAN (De Smet)and DOUBLE BLEACH (Crown Iron Works) and is most used by the industry. The claim to fame is that 50 % of clay can be saved(not to be confused with 50 % of cost because silica is more expensive than clay)
Several other systems where considered and it would take too much time to mention all of them but we only want to mention the system known as LEAD TRIM as used in the USA . In this system the oil sees two filter cakes and by this double bleach 10-15 % oil reduction could be obtained. The change over from an exhausted filter to a fresh filter was done on the basis of chlorophyll level measured.

In all the discussions I had with process specialists and researchers one stand's out and that where the discussions with one of the industries icon's Dr Albert Dijkstra.
We both had different reasons to look at the many ways to safe clay and Albert came with the idea to "Chromatographic" bleach and with initially 5 and later 6 or even 7 filters where the state of the cake and the rise in chlorophyll from the filters was continuously measured while the oil saw a fresh clay only once, he was able to proof our point . Cost and complicated instrumentation shelfed the process but you never know.

The advantage of all the new or modified systems to filter bleaching clays for a filter supplier is that all those that promise to safe clay considerable need more filter equipment . How can we oppose this???
The use of different process , adsorbents, less clay/ re-use of clay's and more optimal use of clays plus process developments in other parts of the process are all being practiced within modern refinery organizations.

OLD HABITS NEVER DIE.

The industry excels in always finding the truth most convenient for the moment. This was the case when I began and it's still the case. We are confronted with clients that run more oil per sqm than anyone else in the industry and the cake has lower oil content than we think is realistic.

Let me try to give some undisputed figures and realize that a few more square meters filter area at the purchase of a filter cost far less than a new filter required because we find out the hard way that the filter was sized to small.

CAPACITY:

In general and for physical refined oils we allow 250-280 kg/m²/hr and this is based on the physical refining of palm oil with 20-40 ppm max phosphatides. In the beginning the filter ,with good clay and excellent refining , will run at over 300 kg/ m²/hr but this is only at the beginning so in average we use the 250-280 figure.

The cake thickness obtained is 18-20 mm which will nicely fit with the 3 inch or 75 mm leaf pitch.

The idea to have a 4 inch leaf spacing in order to accommodate more cake is a non-discussion because the only way to create thicker cakes is to use a filter aid/pre-coat or extra BE and this will lead to more cost.

The filter aid will cost money and the additional oil loss in the cake is another loss. Since the oil loss in the cake is a percentage it is clear that more cake is more oil loss.

INFO SUMMARY:

Caustic refined , 25 ppm soap and 5-10 ppm P filtration rate is 280-300 kg/ sqm/hr and leaf clean/wash frequency every 10-12 weeks.

Physical refined , 2 5 ppm P filtration rate is 250-280 kg/ sqm/hr and leaf clean/wash frequency every 8-10 weeks.

When P goes up wash frequency goes up and in cases where we have > 25 PPM P we see cases where up to every 2 weeks a leaf wash is required.

For BE filtration we can conclude that without FA we will have no more than max 10 -12 kg dry BE per sqm per cycle. Beyond this thickness we will see a deltaP increase to more than 4,5 bar and this is as far as we can go. Only the addition of FA will allow us to build thicker cakes but for what reason ????

In reality we also need a minimum cake to be able to vibrator discharge. This thickness is set at not less than 4-5 kg dry clay because below this level it will be necessary to open the lid of the filter tank and manually assist the cake to fall (rubber mallet) .

CAKE DRYING METHODS:

The cake blowing is std done with steam since this will result in the lowest residual oil contend. The steam consumption is approx 0,5 kg steam at 2-3 barG pressure (140 °C) per kg of dry clay cake based on max 15-20 minutes drying time. The residual oil contend in the spend clay will be approx 22-25%. (as per AOCS method Determination of impurities that are insoluble in petroleum ether)

Silencer and protector

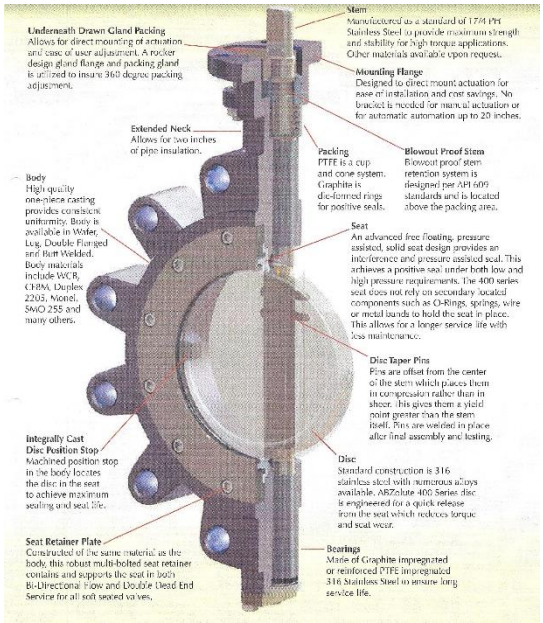
When air/N2 is used the consumption is 0,12-0,15 nm3 /m²/min at 2-3 bar pressure and the residual oil content in the cake is not less than 30-35 %.
If N2 will be used it should be considered that heating up the N2 to 70-80 degrC will result in a comparable result as with steam and we can obtain 26-28% residual oil.
All these figures are based on the use of first class clays and no use of filter aid or pre-coat material. Recently we have come across the statement that the use of (acid activated) cellulose as pre-coat and very short (5 min) cake drying with steam blowing will result in approx 5% less oil than in other conventional systems. We have not seen any evidence of this yet.

AUTOMATION OPTIONS:

For years the industry has been looking for better and more efficient options to filter or clean bleached oil . With the increased capacities and thus the increased number of filters there was the urge for bigger units i.e. more filter area per filter , less operator involvement, and more automation. This covers only the most important and urgent issues and is mainly focused on the vertical tank , vertical leaf filters.

The filter area has gone from max 50 sqm to now 125 sqm per unit which has given the required improvement.(Horizontal tank filters are available to 225 sqm filter area per filter ,have all the same size filter leaves but require much larger footprint and create housekeeping problems when opened to clean) .
Pressure leaf filters are discontinuous and need to be taken off line to be cleaned. For a continuous process always more than 2 filters will be required.
If possible a continuous filter or separator would be the preferred way to work but no feasible alternative has been found so far.
With the need to have more filters also the need for more and better filter automation became evident.
Specially the cake discharge was a point of concern. After the vibration cycle was completed it was not always known that the cake left the filter. With the increased number of filters there was no time anymore to open the filters for visual inspection and the danger of cake accumulating in the filter resulting in bridging and damaged leaves (see Filtering through the news no.17).

The answer is the use of load cell's that will measure the weight of the empty filter tank and if not fully discharged the filter will not be able to go back on stream and repeated vibration or in the worst case open the lid of the filter and manually assist the cake to fall might be necessary. The selected and chosen screen is also an important part of the successful filter performance.
Other design options are vent line all below the walking level, insulation support, high performance cake discharge valves, etc are all available options.



SUMMARY:
With the experience of more than 5000 leaf type filters currently working and processing edible, vegetable and animal oils we consider us your best partner for filtration equipment in these applications. We are aware of the fact that there are a whole range of other filter applications that require a special approach and if required we can give you more details.

Our extensive line of filtration products includes the retractable shell or bundle filters, the Vertical tank, vertical leaf type filters, Pulse type filters and polishing/safety filters (disposable bag filters or cartridge filters) and consumables like filter bags, cartridges and paper pad's.

This paper covers the filtration of bleached oils but can also be used for;

- Post bleach applications.
- Bleaching or Pre-treatment. The preparation step for filtration of clay/ filter aid silica/adsorbent also to remove polyethylene (FTTN No.22).
- Filtration of adsorbents when dry method with adsorbent purification is used and no water wash is practised. (adsorbent like magnesium silicate , silica or equivalent (FTTN No.14).

We have special write up's on these filtration steps and in case of any questions please don't hesitate to contact me or the PMI office where qualified people will be glad to provide you with the correct offers and information.

PMI Sdn,Bhd. Malaysia.

Mr. VT Wong.

(Lochem FV 19022016)