



**FILTERING THROUGH THE NEWS No. 17**

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Attn.:

To whom it may concern

**BRIDGING AND OTHER THINGS TO HARM FILTER LEAVES:**



**LEAF DAMAGE, CORROSION, BRIDGING & STATIC ELECTRICITY:**

There are several possible reasons to damage leaves and all of them can be avoided by taking the right steps in the process. Once the damage has occurred it is an unpleasant and expensive exercise that very often results in discussions between customers and suppliers with no winners.

The client will be convinced he did nothing wrong and the supplier is blamed for the damage that occurred.

In this write up we will try to give you an overview of the most common problems encountered, the reason they occur and how to avoid them.





## STATIC ELECTRICITY;

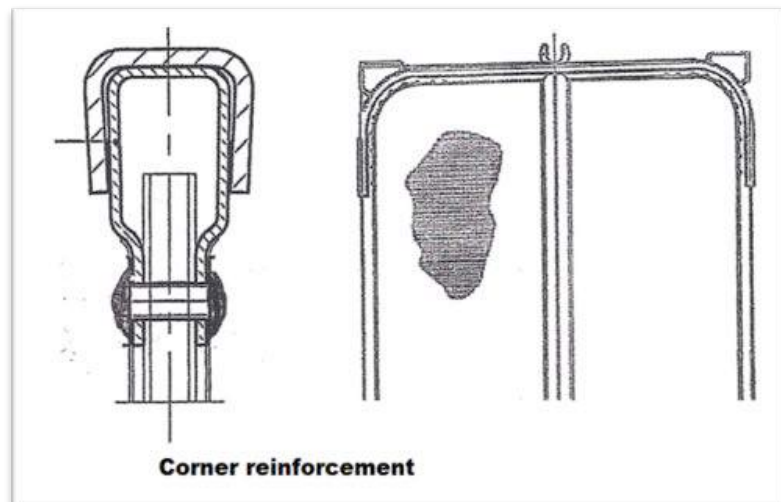
In line with the experiences made in the palm oil there is the risk of static electricity build up. In winterising the effects will not be as obvious as in the fractionation of palm oil where sparks can be seen and heard. In the filter presses used for this duty the filter cloth is woven with (antistatic) wires in the cloth that can be connected to an earthing strip to avoid damage of the cloth. In winterising, depending on the oil type and the filter-aid static electricity is not a common problem but we have to deal in some cases to deal with similar problems.

The wax content other than the stearin content is in the range of 400 to 2500 ppm (exceptions possible) however spark by the static charge can damage the stainless steel wire mesh.

Sparks can cause leaf damage in the form of little holes as a result of the melting of the delicate (0,19 mm – 0,26/0,36 mm) wires in the screen. There is no clear indication of where this will happen and where insufficient earthing of the filter is essential. The leaves can be earthed by using the vibrator shaft that is linked to all the leaves and connect/earth them to the tank/frame. The tank/frame can be connected to the building's earthing system (copper braided strip)

## BRIDGING

This phenomena is the nightmare of every filter operator and in the relationship with the filter leaf manufacturer / suppliers no winners can be found. The much heard of complaint is, "yesterday we had no problem and now, today all the leaves are bended!!"





Many times I explained that if the filter did not change its position, went upside down or started a life of it's own there is nothing wrong with the filter but we have to look into the process. In many cases the vibrator did not at all or only marginal worked. Plugged silencers can cause this (when the exhaust is restricted, it will damp the vibrator very much. The vibrator cake discharge is a compromise already and then the vibrator does not properly work, it is even worse and results in insufficient or no cake discharge at all.)

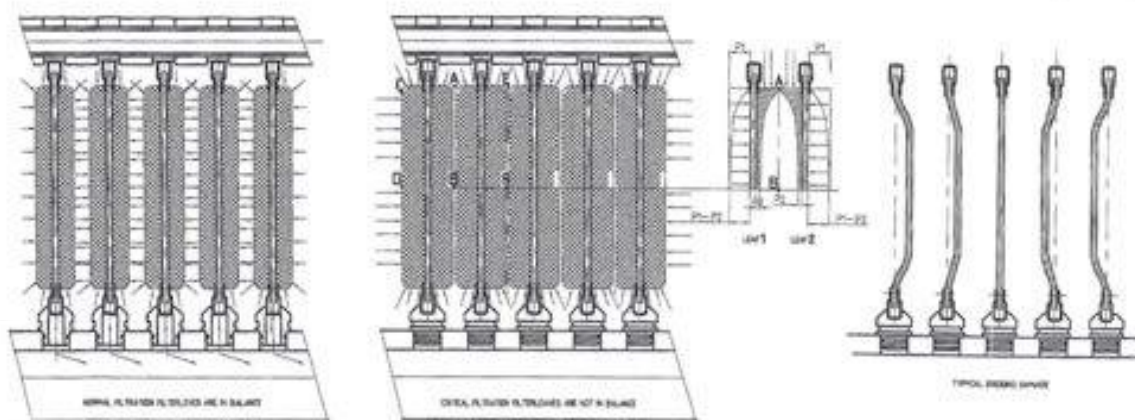
Make sure the vibrator is set at the right pressure (4-6 bar). One can feel the most effective vibration by putting your hand on the leaves and slowly change the pressure until the best and strongest vibration is found.

When the problem however is lying in the oil quality or the type of solids (filter aid, catalyst, foot's or clay) there is little if anything we can do on the filter. The choice of the most optimal screen, the use of a filter aid as pre-coat or body feed is one of the things that can be looked at but the refiners nightmare is to have found the best and cheapest clay /catalyst/filter aid but discover that it will not filter well (sticky, hairy, too fine, etc.). 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.**

The quality of the oil is of great importance and we should aim at low soap, low phosphatides, and low sticky solids. They will block the filtration in a very early part of the usual run and result in thin cakes. One can vibrate the entire building but the cake will not be released form the leaves properly. A minimum of cake is required to work properly and they depend on the type of solids and the filter type.

When the cake discharge is a vibrator assisted manual operation and the tools used are rubber mallets and wooden scraper sticks, one can be sure that damage is just a matter time.

Figure 1:





*Assume: The space between leaf 1 and leaf 2 is completely filled-up with cake  
The pressure in the cake will drop from P1 at "A" to P2 at "B"  
The pressure at C and C stays on P1 and therefor there is still space between leaf 3 and 4  
The pressure over E and F is also P1, so there is still a flow from E to F*

*Result: leaf 1 will be pushed to the right and leaf 2 will be pushed to the left because the cake is compressible. The space between leaf 2 and 3 will be bigger now until somewhere else in the filter package, the space between two leaves is blocked.*

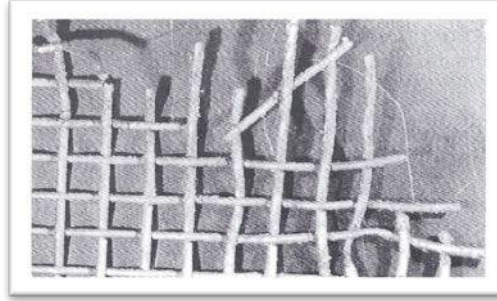
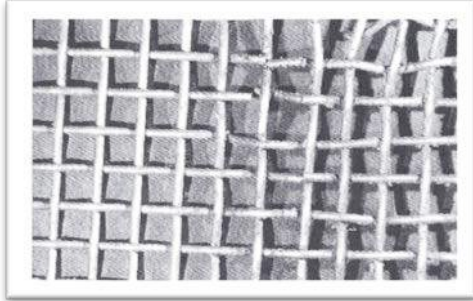
Bridging of the cake is not more than creating a hydraulic out of balance situation. The room between the leaves should not be completely filled up. With leaf pitch of, let us say, 75 mm (3inch) and a leaf thickness of no more than 20 mm we have room for max 25 mm cake thickness and there will be 5 mm room between the cakes. The removal of all the cake from the leaves and the filter after every cake discharge should be checked. This used to be done by opening up a filter every 24 hr. to ensure the filter did not build up cake inside the vessel. In more modern installation the filters are mounted on load cell's (3 bracket see picture) and after every successful discharge the weight of the filter should be back in it set point with margin.

If the cake for whatever reason is not removed for the leaves properly there will be a gradual buildup of cake inside the filter. The cycle is set at a max Delta-P and a max amount of product filtered based on design max Delta-P = 4,5 bar and max cake load in kg/sqm/cycle (bleached oil is max 10-12 kg dry clay per sqm filter area per cycle).

When the filter is over filled with cake i.e. there is no more room between the leaves and the entire space is packed except for the first- and the last leaf. Here the cake can grow more because the tank wall is at bigger distance than the leaf pitch.

The filter area in this case becomes the sum of the first leaf and the last leaf (both on one side only) versus the sum of the rings formed by the cake filling up the space between the other leaves. The hereby created hydraulic out of balance make the leaves bend.





This bending can in a mild form result in the screen being torn from the box channel and will show by slotted holes at the rivets or a clean cut of the screen at the box channel periphery. In the next phase the leaf filter screen will develop horizontal wrinkles and in the last phase the leaves will be pressed to pretzels (beyond repair). Enclosed photos will demonstrate every stage of the described bridging.

Only a better control of the cycle and avoidance of the described bridging will help. Stringer or reinforced leaves will still not be strong enough to stand up against the hydraulic forces.

#### **BLEACHING and MATERIAL CHOICE;**

The filter performance is greatly influenced by the refining method and more specific by the residual soap, Phosphatides, FFA and oxidation products. The simplest one is the caustic refined oil where soap can be a bit high (up to 200 ppm) but mainly we see it in the range of 25-50 ppm. P should be <10 ppm In physical refined oil we will get after the water-wash /degumming approx. 25-40 ppm P and in some refineries they acid treat the oil with phosphoric or citric acid to get the gums hydrated and filter them in the bleaching step.

Not the amount of soap and P worries us too much since it will only have a negative influence on the filtration performance. The slimy, sticky contaminants blind the filter screen and short special cleaning intervals will be the result. Frequent handling of filter leaves and the likelihood of damage to take place do not improve the relationship between the refiner and the filter supplier. This however can be a relatively simply solved by ensuring that the refined oil quality is improved.

Things really go wrong if, the filter leaves shortly after being put into the filter, start showing signs of corrosion. This is first seen at the relative weak filter screen where the wire thickness is ranging from 0,19 to 0,4 mm. Over dosage of acid, acid activated clays and the reining / bleaching temperature are the root of all evil and very often lead to damage beyond repair.



**THIS WILL IN MANY CASES RESULT IN ACCESS ACID (WEAK) AT HIGH TEMPERATURE FORMING EXTREME CORROSIVE CONDITIONS THAT REQUIRE SPECIAL FILTER-SCREEN MATERIAL.** In physical refining of tropical oils we see more and more the need for stainless vertical filter cover discs and even complete stainless vessels.

The disc or vessel material can be AISI 304/1.4301 for the leaves however we need minimum AISI 316L/ 1.4404 frames with center and support screen. The actual filter screen should be made of 904L material or 1.4539. The material 904L or 1.4539 has 19-21 % Cr (=16,5-18,5 in 1.4404), 24-26 % Ni (=11-14 % in 1.4404) and 4-5 % Mo (=2-2,5 % in 1.4404).

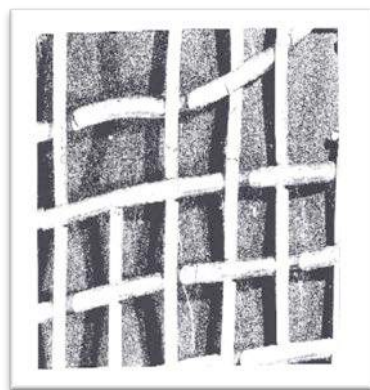
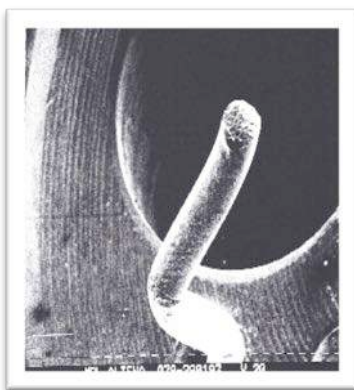
**With over 1000 filters supplied in the bleached oil application worldwide PMI is not prepared to compromise and will only offer the 904 L outer screen in combination with 316L for the rest of the leaf in all bleaching filter applications.**

If a filter leaf cleaning procedure is used, please ensure that also here it is not possible to neutralize the caustic with access of acid resulting in the same corrosive conditions that lead to damaged filter leaves

#### **METHODS THAT IMPROVES THE FILTRATION PERFORMANCES**

Good operation practise is your best guarantee for a good filter performance and using the most optimal bleaching clay in combination with the best filter screen and excellent oil quality are speaking for itself. These seem so obvious but in most cases the problems that we ran into can be traced back to something being wrong in either one of these.

Improved technical solutions and developments also give us the possibility to make the filter cycle easier to handle and what is most important, save on cost.





We like to mention the load cell's that nowadays are used by most of the new plants. The filter tanks mounted on three brackets and all of the three supports are equipped with a load cell. The system is calibrated in such a way that the weight empty i.e. filter completely assembled but without cake is our "O" set point. After the entire cycle is completed and the cake is discharged the load cell measures the empty weight and this has to be back in the "O" range +/- a margin. Is this correct the filter is stand by and ready to go into its next cycle. If the system is not OK with the new weight it will initiate one more cake vibration period and we hope this will ensure that the last bid of spend clay cake left the filter.

If however the system indicates that there is still unexplained weight inside the filter tank the alarm will notify the operator who will have to open the vessel and check the interior. The filter will be easy to access since the chance that it is overfilled with all consequences are very bleak.



#### **"COLD TO HOT" or VV (STEAM) BLOWING INFLUENCE:**

In some cases we have seen the leaves being twisted and bend in applications and circumstances where this never happened before. It took us a while to find out the reason and so be able to explain what happened.

In a winterising application the client was testing the removal of as much as possible residual oil and wax from the spend filter cake before it was discharged from the filter.

Already in other applications we learned that the only way to remove residual oil from the filter cake was blowing more gas or steam, at higher temperature and in some cases longer (but not always).



After a complete bleached oil filter cycle we want to dry the cake and optimal we use steam at 2-3 bar pressure and 140-150 degree C for as long as 20 minutes.

Alternatively use, of inert gas but at elevated temperature of not less than 80 degree C.

For bleached oil it was discovered that if one blows too long with steam, the cake becomes very hard and difficult if at all to remove the cake from the leaves because the clay is more or less baked to the screen. It was late Mr Barry Morton who told the world that only in the beginning of the cake drying cycle we remove oil from clay/cake by the steam pushing it out. Very short after that however "Newton's" law takes over and it is more the principle of neuronal inertia than anything else (fast flowing gas pull's out more liquid). The viscosity of the liquid is rather important for some success however. In this application we steam blow the cake but after 15-20 minutes blowing we remove very little more oil but the extra drying makes the clay bake to the screen and create a very difficult cake to remove.

It will require approx. 0,5-1 kg steam per kg dry clay to dry the cake properly. The use of dry steam is recommended. It will result in a cake with 22-25 % residual oil and this is a figure based on the AOCS petroleum extraction method E115.

**NOTE: In most plants this low residual oil level is never reached**

In Bleaching we deal with a processing temperature of 90-110 degree C while the steam drying is done at 140-150 degree C. This relative small Delta-T does not result in massive differences in elongation of various leaf materials. If we however blow with cold N<sub>2</sub> this Delta-T can and will result in high tension and twisted leaves.

It was however another application that made us aware of this danger. In winterised oil filtration, some clients wanted to increase the dry solids in the spend cake and did this by blowing the cake for several hours and it made the leaves look like "pretzels" when the tank was opened. After cooling down the leaf bundle the twisted leaves did bounce back into their original shape by memory (cold formed profiles) but only partly not entirely. The Delta-T of 146 degree C i.e. 4 degree C to 150 degree C, was too much.





The proper manufacture of the leaves is very essential and the bending of the profile, pre-tensioning of the screen and proper pre-assembly is elementary for a durable and non-twisting design at various temperatures.

It has thought us 3 things:

- 1) If you want to lower the residual oil content in the cake it is important to blow a large volume of steam /gas through the cake in a relative short period. The cake starts to dry very fast and the formed cracks in the cake will allow the steam / gas to pass and follow the way of least resistance.
- 2) Lengthening the drying cycle will have little if any effect except the cake will bake to the screen and will be difficult to remove.
- 3) The temperature of the drying medium will in most cases show exponential effects to the dry ness of the cake. A dry cold gas stream will show higher residual oil contend in the cake than when the gas is heated to at temperature approx. 5-10 degree C higher than the actual process temperature.
- 4) When cake blown in the application of filtered winterised oil, we see in most cases air or nitrogen blown cakes. The amount of gas blown is 0,15-0,20 Nm<sup>3</sup> air or gas per sqm filter area per minute and the duration is 20-30 minutes max. The result is in optima forma 44-48 % residual oil/wax. In recent installations the cake is blown with steam for several hours to reduce the oil/wax content to less than 20 %. In those installations however a severe twisting and bending of the leaves can be observed due to temperature shock i.e. 4-8 degree operating and filtration temperature followed by long and extensive steam drying at 120-130 degree C. **DELTA-T = 112-126 degrC**





**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, and manifold with cake deflection plates between the leaves, etc.

Detailed information and filter layout available and send upon request.

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

VT Wong at PMI-Technology Sdn. Bhd.

Email: [vtwong@pmi-group.com](mailto:vtwong@pmi-group.com).

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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, Condensers, Heaters, Coolers, Reboilers, and General Steel & Stainless Steel Fabrication & Site Erection Works.



**PMI-Technology Sdn Bhd**  
Company No. 568062-K

No. 17 & 19, Jalan Pengacara U1/48,  
Temasya Industrial Park,  
40150 Shah Alam,  
Selangor Darul Ehsan, Malaysia.  
Tel: +603 5569 3993/4240  
Fax: +603 5569 3131  
Email: [info@pmi-group.com](mailto:info@pmi-group.com)  
[www.pmi-group.com](http://www.pmi-group.com)



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