Swiftmode Malaysia (Penang) Sdn. Bhd.

White Paper on SMT Under Stencil Wiper Rolls

Introduction.

The objective of this White Paper is to provide users of the above products in the electronics industry a clear understanding of the different types of stencil cleaning paper/fabrics that are currently available. Fine pitch applications are more the norm now and so the performance of stencil cleaning rolls is more critical than ever before. This White Paper will give solder paste stencil printing engineers and purchasing professionals an insight into the main products on the market, thereby enabling them to make informed decisions.

Main Products in the Market.

- Cellulose / Polyester paper
- Cellulose / Polyester hydro-entangled non woven
- Rayon (viscose) / Polyester paper/fabric
- Rayon (viscose) / Polyester resin bonded
- 100% polypropylene non-woven

Thicknesses vary from 40 grms per m^2 to 65 grms per m^2.

Manufacturing Process and environmental impact.

All cellulose products start with the same process, reacting the cellulose with Sodium Hydroxide (NaOH), which is a very strong alkali (corrosive). This alkali cellulose is then reacted with methyl chloride, chloroacetic acid, ethylene oxide, and/or propylene oxide depending on the type of Cellulose Ether product to be made. All of these chemicals are classified as Hazardous Air Pollutants by the U.S. Environmental Protection Agency.

Rayon (viscose) starts the same as for cellulose and then the alkali cellulose is allowed to age before it is reacted with Carbon Disulphide (CS_2) which is a highly toxic substance and also classified as a Hazardous Pollutant. Typically only 50% of the carbon disulphide can be recovered leaving 50% into the environment. Extrusion and then immersion in a bath of Sulphuric Acid (H_2SO_4) generates Hydrogen Sulphide Gas (H_2S) again classified as a Hazardous Air Pollutant. All in all Rayon is a particularly ‘dirty’ product to make and has been associated with deforestation in developing countries.

Polyester is made by reacting Ethylene Glycol with Terephthalic acid, the process uses a lot of energy and water. Polyester is not very reactive after polymerisation but the chemicals used in the process are highly reactive and toxic with some being carcinogenic, so workers have to be well protected. There always traces of these chemicals in the polyester as it is not possible to polymerise 100%.

Polypropylene uses less energy than any of the above with a lower Carbon Footprint than any other fibre resins. The water used in the cooling process is closed cycle so the water does not go into the environment. The Polyolefins Group, Plastics Europe in Belgium have awarded Polypropylene Environmental Product Declaration. Polypropylene has a low impact on the environment, No Toxic Waste, No Toxic Emissions, No Fluorocarbons, No Halogens ! It is very easy to recycle up to 50 times without reduction in it's properties. Polypropylene has a high calorific value providing high energy for the amount of CO_2 emitted when burned.

Cellulose products need to be bleached and if the process is in a developing country it is most likely that Chlorine Gas or Chlorine dioxide are being used, unlike developed counties such as Europe and USA who use eco-friendly alternatives such as Peroxide.

Independent testing for chlorides has clearly shown :

Cellulose/ Polyester paper contains :		
Source is China		
Chlorides (Cl2)	11.00 µg per grm.	18.7 times that of PP
Sulphates	87.5 µg per grm	
Rayon (viscose)/ Polyester paper/fabric contains :		
Source possibly India		
Chlorides (Cl2)	4.56 µg per grm	7.77 times that of PP
Polypropylene non-woven fabric contains :		
Source ASEAN		
Chlorides (Cl2)	0.587 µg per grm	

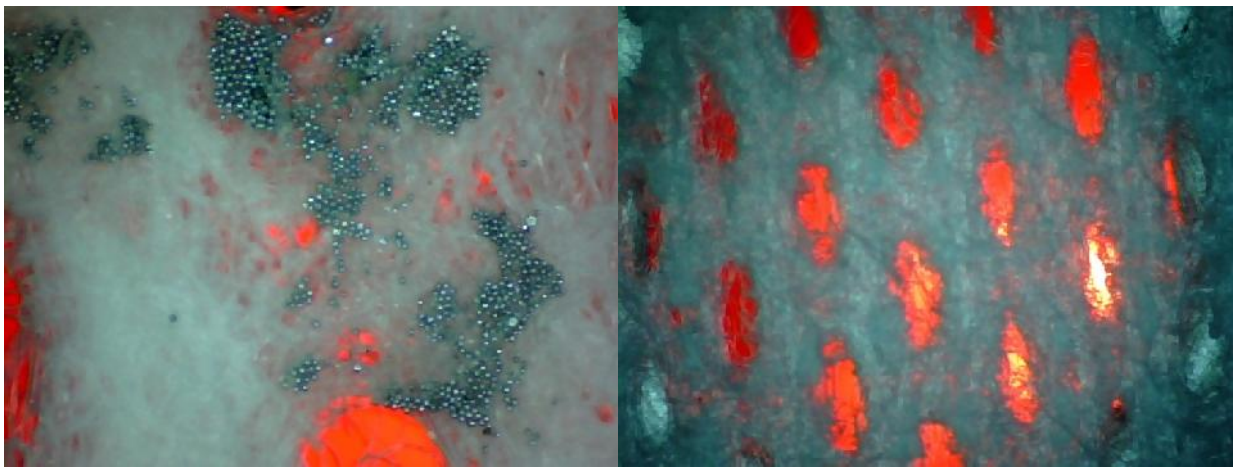
Once again 100% Polypropylene non-woven fabric comes out on top with the lowest chloride content as bleaching is not part of the process.

In conclusion Polypropylene non-woven has the lowest environmental impact of any of the products covered in this White Paper. This surely has to be a serious consideration for any user with an active environmental policy that demonstrates real commitment to use products with low environmental impact.

Construction and how this affects cleaning performance.

Cellulose/Polyester Paper

The fibres have one dominant linear direction due to the process of manufacture and the surface is smooth.
Uni-directional fibres do not have the same cleaning ability as those that are more random (non-wovens) as there are tiny spaces between the lines which will reduce cleaning performance.
These properties result in solder balls remaining on the surface of the paper and so they are not captured within the fibre structure of the paper. This gives a high potential for contamination. The photograph below was taken at 400X magnification and you can see clearly that the solder balls are on the surface of the paper. The right hand photograph shows clearly the dominant fibre direction.



Smooth surface, one dominant fibre direction, and the density of the fibre structure, all define the space for air to pass through the paper and so influence the effectiveness of the vacuum. This product does not perform well especially in the wet vacuum cycles.
The presence of cellulose fibres means that more solvent is needed to provide enough of the cleaning medium because the fibres have to get saturated before any liquid will be on the surface. When the paper is wet the physical properties are totally different from when it is dry, as the fibres swell and the paper has a ‘mushy’ feel to it. This further impedes the vacuum effectiveness and can also lead to paper jams.

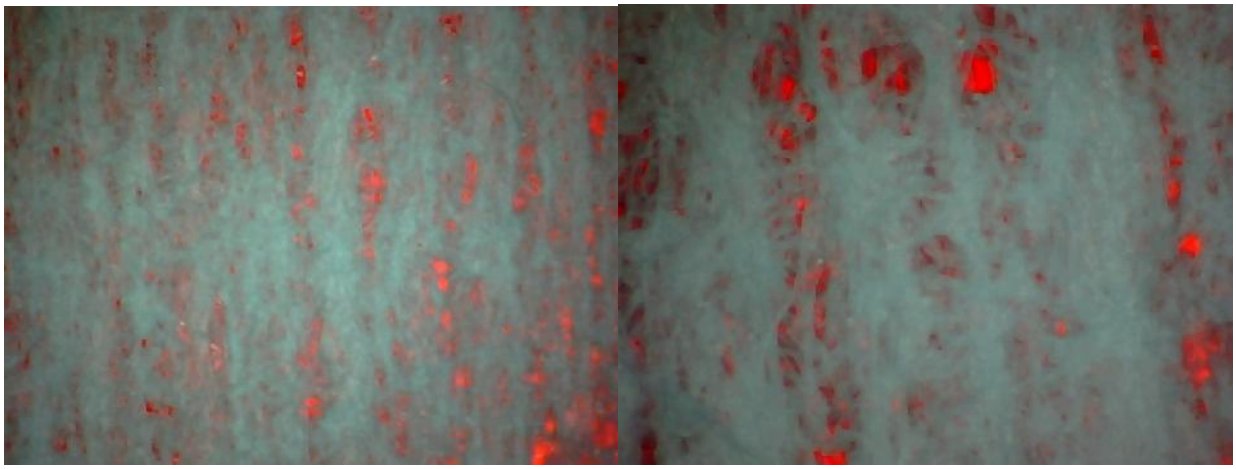
Cellulose/Polyester Paper

The photograph below shows how ineffective this product is in the vacuum cycle. The apertures were completely filled and excess paste removed. You can see clearly that this product doesn't have sufficient porosity for the vacuum to remove the solder paste.

Vacuum Effectiveness photograph

Cellulose/Polyester Hydro entangled

The make up of this product is the same as the one above apart from the fact that no chemical binders are used. The fibres are locked together by the action of high pressure water jets, hydro entangling.
However, the fibres still have a dominant linear direction as shown in the photographs below. This process results in a more compact paper with an even smoother surface and the consequent loss of cleaning power.



Fibre voids are reduced resulting in higher paper area density. Whilst this produces a stronger fabric (which is not necessary for stencil cleaning) it further reduces the effectiveness of vacuum. This is a huge contradiction, making the fabric stronger , which is not necessary, and leaving less space for air to pass through which is necessary for an effective vacuum cycle. Smooth surface, one dominant fibre direction, and density of the fibre structure, all define the space for air to pass through the paper and so influence the effectiveness of the vacuum.
The presence of cellulose fibres means that more solvent is needed to provide enough of the cleaning medium because the fibres have to get saturated before any liquid will be on the surface. When the paper is wet the physical properties are totally different from when it is dry, as the fibres swell and the paper has a ‘mushy’ feel to it. This further impedes the vacuum effectiveness and can also lead to paper jams.

Rayon (viscose) /Polyester paper/fabric

The statements made in the section Cellulose/Polyester Paper are also relevant to this product
In view of the environmental problems in making this product it is an enigma why anyone would wish to offer and/or use it as a SMT Stencil Wiper Roll.
Rayon is often referred to as artificial silk as it has a very smooth, shiny finish, the last thing you would expect to want for stencil cleaning. Smooth surface, one dominant fibre direction, and density of the fibre structure, all define the space for air to pass through the paper and so influence the effectiveness of the vacuum.

The photograph below shows how ineffective this product is in the vacuum cycle.
The apertures were completely filled and excess paste removed. You can see clearly that this product doesn't have sufficient porosity for the vacuum to remove the solder paste.

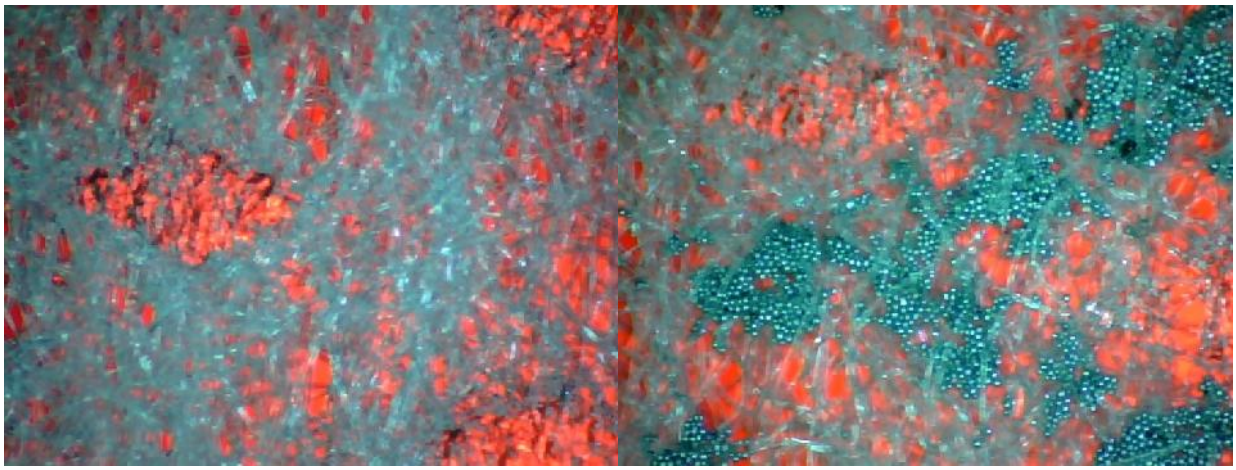
This result is worse than the Cellulose/Polyester paper due to the factors mentioned above. The very smooth texture of the surface is most likely the cause of this.

100% Polypropylene non-woven

The fibres are totally random, there is no dominant fibre direction which provides an optimum cleaning surface.

The relationship between coefficient of friction and abrasion is different for plastics than other materials. The coefficient of friction for polypropylene is between 0.2 and 0.6 but it is not abrasive as it would be in other materials. In under stencil cleaning there is a need for some friction to do effective cleaning and polypropylene provides that without the abrasion which gives a longer stencil life.

The photographs (400X magnification) below confirm that there is no dominant fibre direction, it is completely random. The photograph to the right shows clearly that the solder paste and solder balls are trapped inside the fibre structure thereby preventing any contamination.



100% Polypropylene is a true dry laid non-woven product having all the properties necessary for a high performance stencil wiper roll.
There are sufficient spaces between the fibres to ensure a highly effective vacuum process Wet or Dry. This is confirmed without any doubt in the photograph below.
The apertures were completely filled and excess paste removed. You can see clearly that the Polypropylene non woven is the most effective of all the products discussed here with about a 90% effectiveness.

The fibres do not swell and the physical properties do not change in any way when wet, which is the ideal material for a cleaning process that demands both wet and dry cycles !!!
The surface is NOT smooth due to the thermal bonding process and contributes significantly to it's superior cleaning performance.
The density of the fibres is perfect for the job to be done as super strength is not required but enough to eliminate any fabric breakages.
The solvent is NOT absorbed into the body of the fibres but stays on the outer side putting the solvent where it is needed for cleaning. This gives potential for solvent reductions if engineers are prepared to make small changes depending on the cleaning job to be done. If you never try you never know. IPA is the most common solvent used which is bad for the environment and human bronchial systems so it is worth trying.

Conclusions

It really is amazing that fine pitches are getting more fine, apertures are getting smaller, and yet stencil cleaning products have not kept pace with these developments. It is incredible that companies have just taken the simple route without any thought for all the issues that Stencil Cleaning Wiper Rolls face. They have just taken a standard product available in the market and offered it as a Stencil Wiper Roll ignoring, or not understanding, the environmental issues and the demanding job that the cleaning roll has to do these days.
Developed countries are supposed to have good environmental credentials but companies are buying products made in developing countries knowing very well that they are using chemicals and methods that would not be allowed in their own countries, now how is that for hypocrisy?

Swiftmode Malaysia (Penang) Sdn Bhd have developed a 100% Polypropylene Fabric, **Hyperclean,** specifically for the demanding job it will have to do consistently. This White Paper shows conclusively that **Hyperclean** has the best environmental credentials of any of the products discussed here.
None of the other products discussed have been designed specifically for the job and as a consequence do not have the same performance characteristics as **Hyperclean.**

Hyperclean 100% Polypropylene has been designed to provide high performance cleaning to match not only today's demands but also cope with further reductions in aperture size and finer pitch.

The author of this White Paper, Dennis H. O'Brien, founded Swiftmode in the UK in 1984 and has been mainly involved in ESD packaging products since then.
Swiftmode is renowned for it's culture of Innovation and doing things Differently than others in the same field. **Hyperclean SMT Stencil Wiper Rolls** are a fine example of how we go about our business and we have decided to shout out about our achievements and have the confidence to clinically and technically compare our products with our competitors, giving users for the First Time unbiased and credible information to assist them in making the right decision for their companies and the environment.

If this White Paper has provoked your thought process about Stencil Wiper Rolls like never before visit our website www.swiftmode.com or contact me directly on my email: dobrien@polygroup.biz or contact Eunice Wong on Malaysia.sales@swiftmode.com