



MICREX®/Microcreper™
Technical Note #116
Substrate Design and Modification for The Micrex Process

I. Overview:

Fundamental to Micrex's technology is an effort to expand the range of materials that can be processed. Historically this has occurred because of the development of new Micrex/Microcreper configurations. There are now seven.

Many successful commercial Microcreped products have resulted when characteristics of the incoming substrate have also been optimized for Microcreping. While optimization may initially seem daunting, very often they require only small changes ("de-tuning") and can result in reduction in the incoming substrates cost as well as processing costs..

A seemingly insignificant variation in the base web can potentially have huge impact on how the material processes on the Micrex/Microcreper. While indeed The Micrex Process is complex, it is mechanical, and when practiced properly with the same inputs, the resulting creped product will be the same from run to run. Unexplained variations in the creped product are often traced to a heretofore unknown variation in the base material before creping, in what the customer presumed were identical materials. This note is to give the product designer a better understanding of which variations are critical and which are not.

Two cautions:

1. The "Rules of Thumb" listed in this note while applicable to a wide range of sheet materials (e.g., nonwovens, textiles, papers, films, composites) are generalizations. Deviating from the rules can make for some interesting and unique products.
2. This note is directed more toward the generalist rather than the technologist with the hope that it will then be useful to both.



II: General “Rules of Thumb”

Web:

Weight:

Very light or very heavy webs are more difficult to process than those in-between. While the definition of each depends a lot on other characteristics of the sheet, generally, light would be less than 20 gsm and heavy more than 120 gsm.

Density, Bonding, Calendaring, Unevenness:

Roll goods producers are rewarded for making a flat sheet. The Micrex Process is less concerned about the flatness of the sheet than about formation and density, evenness or uniformity:

- All things being equal -- a less dense sheet is easier to crepe up to the point that the sheet delaminates
- This is also true across the web. Areas of high and low density which might be invisible in the unprocessed material, may translate into areas of uneven compaction or defects when Microcreped.

Problems that might be solved during bonding/calendaring can actually become worse for the Microcreping process.

Surface:

The Micrex Process works through a balance between the material being frictionally driven into the process (feeding), and then collapsing in the compaction zone. If during the substrates manufacturing process a fine pattern is created in the bottom of the sheet (defined as the side against the Micrex/Microcreper main roll) feed will be improved.

Sidedness:

Mixtures of materials will often have layers of different types of fibers. For example, a blend of rayon and polypropylene where the PP was sandwiched between layers of rayon would have much different creping characteristics than if the rayon is in the center and PP on the surfaces. Rayon, compared with PP, has



greater frictional properties and is more easily driven through the creping process. Wood pulp has properties similar to rayon.

Fiber:

Type or Polymer:

Many different types and combinations of fibers are Microcreped. They range from 100% cotton, rayon, pulp, wool, and polymeric fibers, to various blends. The choices of fibers and blend are initially determined by the intended end use. Since the character of the web can be changed dramatically by Microcreping, the correct recipe for these webs often needs to be adjusted for Microcreping.

Several Microcreping applications involve heat-setting thermoplastic fibers and the thermal response characteristic of the fibers is critical. The Microcreper through a combination of heating the main roll and variations in the frictional heat generated by the process, will crepe the entire sheet structure as well as individual fibers.

There are many kinds of stretch as well of degrees of each. Elastic stretch, (stretch and recovery) comfort stretch, conformable stretch with controlled recovery, and stretch without recovery are four broad categories. Selecting the appropriate fiber to achieve the type of stretch required can involve several iterations of trials.

Stretch of 25% is usually easy to accomplish. The percent recovery (regain) depends on several factors including the load applied, the dwell time it is held at that load, and the time allowed for recovery. The resilience characteristic of the polymer, the temperature at which it is heat set, and the denier of the fibers, among several other variables.

Listed in order of highest probable regain, the following are candidate polymers:

1. Nylon (6,6)
2. Polyester (highly drawn)
3. Polypropylene (large denier)



Focusing on polyester (still one of the most used polymers in the nonwovens industry) there is a very large range of deniers, responses to temperature, etc. Some are bi-components and within this group there is a similarly large variety of fibers. The probable results of Microcreping will depend on the specific properties of the component fibers in the substrate.

Most polyesters are suitable for our process, but some are not and can cause significant problems. An example is a product made using polyester bi-component fibers where the sheath is an amorphous low melting point polyester or polypropylene. We find that in this category of fibers some can cause significant problems in our process because the temperature required to heat set the fibers core is well above the melting point of the sheath resulting in contaminating our equipment and an expensive clean-up. Side by side bicomponent fibers can also present similar problems. Decisions on these issues partly depend on the properties required in the creped product.

The thermal response of the entire fiber is critical. As a general rule amorphous polyester will have less recovery. For example, crystalline (highly drawn) polyester can be creped at a higher temperature than amorphous polyester and the web will have better regain. If crystallinity is increased during extrusion, fibers will have a different response to temperature and a wider thermal range in which the fibers can be shaped, but not melted.*

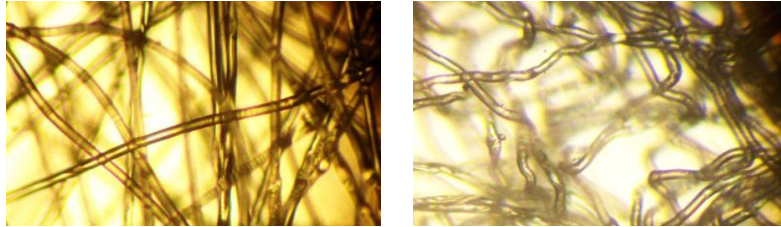
Blends of Fibers:

Often a combination of thermoplastic fibers and non-thermoplastic fibers will make for a substrate which performs better on the Microcreper – even in an application which relies on heat setting of thermoplastic fiber. Pulp and polyester wipes are one example.

There are two reasons for this:

1. The non-thermoplastic fibers don't soften when heated and provide a matrix in which web integrity is maintained but the thermoplastic fibers can be softened and crimped by the Microcreping process without the sheet becoming plasticized,
2. Often these non-thermoplastic fibers will also provide a better “gripping” surface on the main roll of the Microcreper – enhancing the performance of the entire system.

* Note that the thermoplastic character of fibers is, in some cases, not well documented by their manufacturers. Further due-diligence is often required.



Microphotographs of polypropylene fibers before and after Microcreping

Denier/dtex:

As a general principal, increased fiber diameter and web thickness will make for better regain after deformation either from MD stretch or Z direction compression.

Fiber orientation within the web:

Creping acts on the web by compacting it in the machine direction. Having a greater percentage of fibers oriented in the machine direction will allow more fibers to be crimped and the Micrex/Microcreper to act more efficiently on the web structure.

Fiber length:

In some cases, long fibers are better at retaining a crepe profile than short fibers.



Finish:

There is an entire industry supplying various kinds of finishes to enhance webs. Since the range of options is almost limitless, we will offer only a few general rules about their use:

1. The thermal response characteristics of any binder must coordinate with that of the fibers and the temperature profile of the Micrex Process. Poorly cross-linked acrylic latex binders can react to heat by becoming unstable and serve as an example of a difficult to crepe chemical additive.
2. “Lubricants”, surfactants or softeners that will either transfer to the main roll of the Microcreper or alter the slip/stick characteristics of the sheet can have a negative impact on Microcreping. Discussion of additives at an early stage in a project allows you and Micrex to manage this issue.
3. Silicone in all but the minutest quantity is hugely negative to the Microcreping process. This applies to a finish for individual fibers or for the entire substrate.
4. Printing ink, to the Microcreper, is a type of finish. Viewed as such, printing should be distributed across a web as evenly as possible. Less printing is better than more. If a print pattern is needed, it will be useful to discuss the functional influence with Micrex before the choice of pattern is finalized.

III. Summary - Dead-fold Characteristic:

As a summary concept, consider that Microcreping is about making folds in a material, and how well these folds will be retained in use. For example, a thin substrate made of very fine, low crystallinity fibers, might easily have a high degree of dead fold (crepe). . This same web however, may also have very little resistance (modulus) in use and would easily release its crepe profile. A thicker web using long fibers made with a very crystalline polymer, and oriented in the machine direction might be more difficult to crepe, but from a systemic perspective could be a much better performing product due to its more durable crepe.