CASE STUDY

Adding Stretch and Conformability to Scotchcast™ Castwrap (First Generation)

Summary

At MICREX, we take confidentiality very seriously. For this reason we do not publicize current projects; however, we do highlight mature applications. These provide an inside look into the MICREX Technology and how trials merge with customer technology to add desirable properties to enhance existing products, such as absorbency, bulk, extensibility and stretch, decorative effects, and softness, drape and hand.

Recognizing a need for a non-fiberglass tape in its portfolio, in the 1990's 3M™ was looking to engineer the desired product characteristics, conformability and stretch, into its backing material. MICREX delivered the solution, adding stretch using its MICREX®/Microcreper™ to mechanically compact the material backing. The resulting product, a combination of the MICREX process and a unique resin system, provided 3M with a superior product and a strong patent position.

"The MICREX Process added much needed conformability and stretch to our castwrap, giving 3M a superior product and a strong patent position."

Dr. Kurt Allenberg
former Product Development Specialist for 3M

Challenge and Requirements

Casting Tapes

Orthopedic casting tapes have been used for more than 150 years in the treatment of body injuries, such as fractures, sprains and strains. Casting tapes allow for partial or complete immobilization of a body part to promote complete healing. The more complex the fracture is, the more necessary it is to use an adaptive product to stabilize the body part.

Technically, every casting tape consists of a backing material and a resin system. The function of the backing is to carry the resin, and the function of the resin is to transform from a viscous state to a rigid state through some kind of chemical reaction upon activation. The focus of this case study is on engineering the desired product characteristics into the backing material.

If you would like to discuss a trial or have any questions, please contact:

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"The MICREX/Microcreper successfully compacted our material by 50%, allowing us to achieve 75% stretch."

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Types of Casting Tapes

Type	Backing	Resin	Activation
Plaster of Paris	Gauze	Gypsum	Water
Synthetics	*Fiberglass knit	Acrylic	UV-Light
	Fiberglass knit	Polyurethane	Water
	Polypropylene knit	Polyurethane	Water
	Polyester knit	Polyurethane	Water

* Light activated casting tapes were the first synthetic casting tapes developed. At the time of this case study, there had been no light activated tapes on the market for 10-15 years.

The traditional system, based on Plaster of Paris, was the cheapest and most moldable tape available; however, it was also messy, heavy, not fully set to weight bearing until 24-48 hours after application, was not X-ray translucent, and disintegrated with wetting and wear.

A later development, water activated fiberglass tapes, provided a strong, lightweight, non-messy solution, which could be set to weight bearing within 30 minutes. It could also withstand wetness with improved durability and X-ray translucency.

A third material category, water activated polypropylene or polyester tape, proved superior in both durability and translucency. These tapes are similar to fiberglass tapes in set time and wetting properties and are lighter, but not as strong.

Market Size (estimates at time of case study):

Total Casting Tapes	300 MM USD
Synthetic/plaster	50/50
Shares:	The three major producers (including 3M) each had between 20-30% of the total market

*3M was only in the synthetic market and was a market leader in that segment.

More than 90% of the synthetic casting tapes were fiberglass. The most prominent non-fiberglass tapes in the market were:

Dynacast Optima (S&N) – polypropylene

DeltaCast Elite (J&J) – polyester

Castflex 8 (Alcare) – polyester

Scotchcast™ Poly (3M) – polyester

A number of local brands existed, predominantly in Korea.

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"The Micrex/Microcreper provided stretch by mechanically compacting the backing of 3M's material."

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The Need for a Non-Fiberglass Solution

All casting tapes are removed using a cast saw, which produces a certain amount of sawdust. Although demonstrated to be harmless, there has been a negative customer perception (especially in Europe) associated with fiberglass dust. A polypropylene tape had been available in the European market for more than 10 years; however, polyester tapes had only recently been introduced in Europe by J&J. The market was headed toward non-fiberglass tapes. 3M recognized this need for a non-fiberglass tape in its product portfolio, in order to serve customers with a more complete range of product offerings.

The Process

As part of an earlier development program, 3M had been looking at various polyester knit designs. It became clear that the focus should be on conformability of the backing, and one way to improve conformability would be to increase lengthwise stretch. Traditionally there had been two ways to provide stretch: incorporate elastic fibers into the warp direction, or incorporate stretchable, non-elastic, fibers into the warp direction.

3M turned to MICREX for a third solution: to provide stretch by mechanically compacting the backing. Although 3M had already purchased a lab-scale MICREX/Microcreper, and initial trials showed some promise, 3M approached MICREX to conduct a development program at the MICREX facility.

Initial trials focused on testing a variety of material structures and compositions for two things: suitability to the MICREX process and performance during later stages in the manufacturing process when the resin system was applied to the product. Field testing determined that a stretch / recovery characteristic of 70 – 90% after Microcreping was optimal for the application.

In the case of the Scotchcast product, in order to achieve 75% stretch, it was determined that the material needed to be compacted 50% by the MICREX/Microcreper. Due to the nature of the particular polyester web, the web permanently retained almost 1/3 of the compaction.

Processing a single narrow web with 50% compaction presented a variety of problems with material handling. Initial product concept testing was encouraging; however, the economics of the process was becoming an issue. Unless significant new economies could be found, the product would be killed.

A further challenge to overcome: each web had unique product characteristics that prevented slitting; therefore, 3M set out to determine the maximum number of individual rolls that could be Microcreped at one time. To develop a material and process specification that could be priced at a reasonable level required multiple trials. Six months of trials yielded the desired results: systems were developed to process from 4 to 11 (depending upon web width) individual webs on one core.

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MICREX is the developer of an enabling technology which imparts properties of softness/drape and hand, stretch and extensibility, absorbency, bulk, pre-shrinking and decorative effects to nonwovens, films, textiles, papers, and composites. This technology — embodied in an expanding series of machine configurations known as MICREX®/Microcrepers™ — allows companies to dramatically expand the use and application for traditional and new sheet materials.

Results

At this stage of development, with much improvement in throughput, economics were still an issue. Working with MICREX, a new test suite of process conditions was designed to see if the same web characteristics could be achieved at a significantly higher operating speed. It was found that by slightly elevating the temperature of the main roll, while at the same time increasing the process speed 100%, the lack of dwell time in the process was more than compensated for by a mechanically produced heat rise as the material passed through the treatment cavity. The processing cost (under limited production) was now down to $0.02 per linear yard – a level that was acceptable in the final cost calculation. In order to facilitate the introduction of the product, MICREX agreed to do the Microcreping at their facility outside of Boston.

The product was successfully introduced in selected European markets. Response from medical professionals was excellent: they found that the new 3M tape could more easily immobilize more complex fractures. Further, the unique non-elastic stretch of the product was perceived to present less risk of constriction.

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We wish to acknowledge Dr. Kurt Allenberg for his contribution to this case study. Dr. Allenberg, a Danish citizen, was a Product Development Specialist at 3M during this project.