New Development of Nonwovens Technology and Application

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Background of Growth

- Technical Textiles
- Advanced Fibers
- Nonwovens
- Recycle, Ecology
DEFINITION OF NONWOVENS

(ISO) 2011.10

Nonwovens are structures of textile materials, such as fibres, continuous filaments, or chopped yarns of any nature or origin, that have been formed into webs by any means, and bonded together by any means, excluding the interlacing of yarns as in woven fabric, knitted fabric, laces, braided fabric, tufted fabric.

NOTE: Film and paper structures are not considered as nonwovens
<table>
<thead>
<tr>
<th>Web Forming</th>
<th>Web Bonding</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Wet Laid (Carding, Air Laid)</td>
<td>① Chemical Bonding</td>
</tr>
<tr>
<td>② Dry Laid (Honshu method)</td>
<td>② Thermal Bonding (Through air, calender, Ultra sonic, High-frequency)</td>
</tr>
<tr>
<td>③ Spunmelt (Spunbond, Meltblown)</td>
<td>③ Needle Punching</td>
</tr>
<tr>
<td>④ Others (Burst Fiber, Film Split)</td>
<td>④ Spunlace (SJ method)</td>
</tr>
<tr>
<td></td>
<td>⑤ Stitch Bonding (Maliwatt, Kunit)</td>
</tr>
<tr>
<td></td>
<td>⑥ Powder Bonding</td>
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<tr>
<td></td>
<td>⑦ Solvent Bonding</td>
</tr>
</tbody>
</table>
Structural Advantage of Nonwovens

**Special Pore Structure**
- Shape of Pore Size Distribution
- Diversity of Pore Size

**High Loft**
- (differ with nonwovens production method)
- Cushion, Acoustic and heat insulation

**Special Fibrous Assemblies**
- Flexibility
- Planar Orientation
Uses of Nonwovens in Technical Application

- Absorbency
- Filtration
- Drainage
- Insulation Separation
- Packing
- Protection
- Reinforcement

Uses of Nonwovens
Research concerned with Nonwovens

- Composite Nonwovens
- High Quality
- High Functionality
Compounding Technology

Compound of Material

Compound of Process

Compound of Structure

Compound of Product

Composite Nonwovens
Perfojet (Spunjet) (Spunbond + Spunlace)
Air Laid Composite Nonwoven

Air Laid + Spunlace

Air Laid + Spunbond/Meltblown

Function / Tenacity + Hydrophilic + Handle
Compound Structure By CORMATEX
Needle-punching

Main fields of research

- Surface modification by special needling process (velourisation)
- 3D structures for specific applications produced by web-linking system (NAPCO®)
- Needle punching as substitution of sewing
Japanese Original Technology Developed in Past

- Honshu method (Air Laid)
- Wet Spunbonding
- CLAF, MILIFE
## Manufacturing Method

<table>
<thead>
<tr>
<th>Forming Type</th>
<th>Screen</th>
<th>Picker Rotor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Specified</td>
<td>Specified</td>
</tr>
<tr>
<td></td>
<td>Honshu</td>
<td>J&amp;J</td>
</tr>
<tr>
<td></td>
<td>Karl Kroyer</td>
<td>K-C</td>
</tr>
<tr>
<td></td>
<td>(M&amp;J)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dan–Web</td>
<td>Scott</td>
</tr>
<tr>
<td></td>
<td><strong>Three</strong></td>
<td><strong>Major Methods</strong></td>
</tr>
</tbody>
</table>
BASIC HEAD OF HONSHU METHOD
MD DIRECTION

- Out put Power
- Air Flow
- Staple Fiber
- Fixed Screen
- Web Forming
- Suction
- Wire Net
- Cylindrical Screen
- Individualized Fibers
- Defiberized Pulp
- Casing
- Forming Wire
- Mat Former
- Wire Net
CLAF, MILIFE
(JX Nippon ANCl,Inc.)

CLAF consists of two layers of co-extruded and fibrillated polyolefin films that are oriented in both machine and cross directions then thermally bonded together into nonwoven mesh product.

MILIFE is a unique cross-laminated nonwoven made in a sophisticated proprietary process that combines orientation and spinning technology.
PROPERTIES OF MILIFE
Totally new non woven based on unique and proprietary JX technology.
Extremely low basis weight is possible with full width (2.2m).

MILIFE GRADE TYPICAL PROPERTIES

<table>
<thead>
<tr>
<th>Grade</th>
<th>Basis Weight [g/m²]</th>
<th>Thickness [mm]</th>
<th>Tensile strength [N/50mm]</th>
<th>Tensile Modulus at 0.5% elongation [N/60mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MD</td>
<td>CD</td>
<td>MD</td>
<td>CD</td>
</tr>
<tr>
<td>T05</td>
<td>5</td>
<td>0.05</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>T10</td>
<td>10</td>
<td>0.07</td>
<td>70</td>
<td>—</td>
</tr>
<tr>
<td>T15</td>
<td>15</td>
<td>0.07</td>
<td>105</td>
<td>—</td>
</tr>
<tr>
<td>T20</td>
<td>20</td>
<td>0.08</td>
<td>140</td>
<td>—</td>
</tr>
<tr>
<td>TY050FE</td>
<td>10</td>
<td>0.07</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>TY150FE</td>
<td>20</td>
<td>0.10</td>
<td>70</td>
<td>45</td>
</tr>
<tr>
<td>TY1515FE</td>
<td>30</td>
<td>0.12</td>
<td>105</td>
<td>65</td>
</tr>
<tr>
<td>TY2002FE</td>
<td>40</td>
<td>0.13</td>
<td>140</td>
<td>90</td>
</tr>
</tbody>
</table>

*The information contained herein is furnished without charge or obligation and the recipient assumes all responsibility for its use.
Any properties listed herein are provided as information only and in no way create any warranty.

MILIFE STRUCTURE
This structure gives MILIFE extreme uniformity

THIN PROFILE
*MILIFE contains no weave or knit
*Aligned filament structure reduces overlapping

MILIFE FIBER MAGNIFICATION
Wet Spunbonding (Bemliese) (AsahiKASEI Fibers corporation)

Bemliese is the world’s only cellulosic continuous filament nonwoven. Ultralow lint generation, superior liquid absorbency, thermal stability, pick-up, purity and biodegradability. All inherent in its 100% cuprammonium rayon composition.

1) Cotton is dissolved in special solution.
2) Solution is extruded to running water, and make them solidified.
3) Web is formed on the conveyor net.
4) Web is washed in water.
5) Nonwovens does own gluing at the same time as a web is dried.
Wet Spunbonding

Spinning  Washing  Drying + Winding
Steam jet technology was pioneered by Mitsubishi Rayon Engineering with the introduction of the world’s first dedicated factory. Both companies are collaborating on the technology for form processing nonwovens. The newly developed nonwoven is based on Kuraray’s proprietary materials, leveraging the special features of EVAL fiber SOPHISTA, water-soluble KURALON-Ⅱ and microcrimp fiber. Possessing unique thermal adhesive properties, SOPHISTA raw fiber contains a hydrophilic group and can, in high volumes, be made into new types of high-strength nonwovens. And by using microcrimp as raw fiber, nonwovens with remarkable stretch can be quickly produced.
SJ method
(KURARAY KURAFLEX Co., Ltd)
Compact Card – The future of carding

Universal carding unit for short staple webs with roller/aerodynamical doffing

Our family tradition is known for innovative solutions for the non-wovens industry. The new HERGETH carding unit offers many new advantages for carding, operation and maintenance.

The process starts with our new fine opening unit with mechanical doффing. This allows feeding the card with little air volume, but very fine opened fibres. A circular feed line ensures the fibres are well distributed in the chute feed as the air travels with high speed all the way across the width. De-mixing of heavy and light tufts as it happens in conventional chutes with dead-end systems is avoided. In the chute the fibres are separated from the air by blade bars with a progressive profile. This profile reduces the risk of fibres twisting around the bars and blocking the system. The chute is made of segments that can be manually set for forming a profile. As an option the chute can be fitted with an automatic regulation system across the width.
Ultrasonic transducers 4) measure the density of the fibres in the chute. A PID regulation controls the actuators that position the segments of the chute to achieve a uniform weight across the width.

The fibres enter the card by a large diameter feed roll 5). The big diameter ensures a better control of the fibre column entering the unit. The card works with unidirectional feed. A feed table elongated by spring sheets 6) ensures control of the fibres far into the nip point avoiding fibre blocks entering the card. The three main cylinders 7) also have the same diameter like the feed roll. By the use of three cylinders the fibres can be gently speed up to the necessary surface speed and draft. The carding is done by up to 15 carding strips 8) giving about the carding power of a card with 15 rollers and strippers. The carding strips are easy to exchange and have a moderate price.

The carding strips can be adapted to the material processed. If less carding power is required the carding strips can be replaced by blanks.

A unique feature is the 2H roller 9). This roller skims the surplus fibres from the second cylinder. The surplus fibres are sucked 10) and reintroduced at the feeding machine reducing the chance of thick spots and clouds.

The carded fibres are doffed by a conventional doffer 11) and delivered by two delivery rollers – one wire-wound 12), one fluted 13) – for webs orientated in machine direction. The delivery unit can alternatively be equipped by one or two stuffer rollers 14) for heavy webs.
Dry Impregnation Technology by Fibroline (D-Preg)
Pattern of Nonwovens by neXimaging (Andritz perfojet)
NANOVAL has developed a spinning process in which continuous filaments are spun from orifices, normally holes, and split-up from the exiting liquid monofilaments into a multitude of finer filaments. This effect occurs less by drawing than by shear forces of an accompanying air flow, inducing a pressure into the monofilaments until they burst, breaking up the outer skin, the sheath. From one spin-hole several, up to more than 100 single filaments are generated. All types of meltspinnable polymers and spin-solutions can be used.
Principle of Biax Spinnerette
Fine Meltblown System By KASEN

KASEN Fine Melt Blown system
Force spinning
(FibeRio Technology)

HOW DOES IT WORK?

1. Molten or solution material is placed inside a spinneret.

2. Spinneret rotates and pushes material through orifices by centrifugal force.

3. Material is jetted into air and attenuated into fibers by inertial shear forces.
### Nonwoven application
### Number of Exhibitors in INDEX2014

<table>
<thead>
<tr>
<th>Application</th>
<th>Exhibitors</th>
</tr>
</thead>
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<td>133</td>
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<tr>
<td>2. Medical</td>
<td>123</td>
</tr>
<tr>
<td>3. Home furnishings and furniture</td>
<td>100 (carpet 26)</td>
</tr>
<tr>
<td>4. Civil engineering/building</td>
<td>99 (37/62)</td>
</tr>
<tr>
<td>5. Household cleaning</td>
<td>91</td>
</tr>
<tr>
<td>6. Industrial cleaning/wiping</td>
<td>87</td>
</tr>
<tr>
<td>7. Personal care wipes</td>
<td>80</td>
</tr>
<tr>
<td>8. Agriculture/Horticulture</td>
<td>80</td>
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<tr>
<td>9. Automobile</td>
<td>77</td>
</tr>
<tr>
<td>10. Packaging</td>
<td>76</td>
</tr>
<tr>
<td>11. Filtration (liquid)</td>
<td>68</td>
</tr>
<tr>
<td>12. Protective wear</td>
<td>52</td>
</tr>
<tr>
<td>13. Shoes</td>
<td>47</td>
</tr>
<tr>
<td>14. Electric applications</td>
<td>37 (15/22)</td>
</tr>
</tbody>
</table>
Precise
(AsahiKASEI Fibers Corporation)

Precise has excellent uniformity compared to conventional spunbonded nonwoven, is SMS structure with polyester fiber. Applications of this product are membrane substrate, filter, filtering bag, electronic materials, medical products, adhesive tape.

Features of Precise are superior uniformity, high filtration efficiency, high barrier efficiency and wide product range.
What is Precisé™?

Precisé™ is a multifunctional nonwoven fabric with high barrier efficiency deriving from its ultrafine fiber layer.

The name précisé derives from the French word meaning "accurate" and "precise".
A nonwoven, V-Lap is vertically lapped nonwoven. Because of this, by combining with high functionality raw synthetic staple fibers ELK(Elastomer binding fiber), SOLOTEX(PTT fiber) and soon, superb characteristics can be achieved such as high rebounding, voluminous, light weight and highly breathable, as well as being easy to bend and easy mold. In addition, its sound absorbing characteristics can be controlled by combining with a surface materials and press processing.
This product is a composite structure using meltblown nonwoven (1～2μ) as a main filter and spunbond nonwoven (over 10μ) as a pre-filter.

Basic concepts in development are as follows.

① To use fiber as fine as possible.
② To raise distributability of fibers.
③ To improve the surface characteristics.
This product is the cushioning medium which entangled a lot of mono-filament like a three dimensional spring. There are two kinds, soft type and hard type, and the cross sectional shape is circular (soft type) and hollow circular (hard type). In circular type, fiber diameter is 0.2~0.5mm, and 0.4~1.5mm in hollow circular type. The thickness of product is 15~100mm.
Flushable Nonwovens
(Suominen Nonwovens)
Guidelines for Assessing the Flushability of Disposable Nonwoven Products (INDA/EDANA)

FG501: TOILET & DRAINLINE
FG502: SLOSH BOX DISINTEGRATION TEST
FG503: HOUSEHOLD PUMP TEST
FG504: SETTLING TEST
FG505: AEROBIC BIODISINTEGRATION
FG506: ANAEROBIC BIODISINTEGRATION
FG507: MUNICIPAL PUMP TEST

(INDA/EDANA GD3 Flushability Assessment)
General Trends in Nonwovens Products

From Hard to Soft

From Binder Use to Non-binder

From Coarse Fiber to Fine Fibers

From Single Structure to Composite Structure

From Disposable to Semi-disposable
Thank you very much for your attention.

Osamu Yaida