

Nonwovens: defining the often used but rarely known or seen

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In spite of not being listed in dictionaries and encyclopaedias or presently having an acceptable definition, nonwovens continue to grow at a phenomenal rate with yearly sales of \$1.8 billion in the United States.

Unlike the airplane, laser, or transistor, the exact date that nonwovens were invented is obscure. Perhaps even more obscure is the name of the person who invented them. For example some of the early papers made by the inventor of paper Ts'ai Lun in A.D. 105 are known to have fibers from fish nets added to the furnish as a means of reinforcement. The paper machine developed by the Fourdrinier brothers, while used originally to make paper, has the capability and in fact has produced and continues to produce certain forms of nonwovens. In 1853, Bellford was issued British patent 114 for making carded nonwovens. Owens-Corning in 1937, produced the first melt blown product when they began making glass insulation material. Because nonwovens evolved from so many different directions at widely differing times, to try to pinpoint when nonwovens were invented and by whom, is about as difficult to establish as determining the exact spoons full of water that there are in the ocean.

What has proven equally difficult is to establish an acceptable definition for nonwovens. The ISO definition of a nonwoven (1) is

A manufactured sheet, web, or batt of directionally or randomly orientated fibres, bonded by friction, and/or cohesion and/or adhesion, excluding paper and products which are woven, knitted, tufted, stitch-bonded incorporating binding yarns or filaments, or felted by wet-milling, whether or not additionally needled. The fibres may be of natural or manmade origin. They may be staple or continuous filaments or be formed *in situ*.

To distinguish wet-laid nonwovens from wet-laid papers, a material would be regarded as a nonwoven if:

- More than 50% by mass of its fibrous content is made up of fibres (excluding chemically digested vegetable fibres) with a length-to-diameter ratio greater than 300
- More than 30% by mass of its fibrous content is made up of fibres (excluding chemically digested vegetable fibres) with a length-to-diameter ratio greater than 300
- Density is less than 0.40 g/cm³.*

The commonly used term 'needlefelt' has given rise to

some confusion since it restrictively associates needling with felting or felt-like products. In fact, needling (mechanical interlocking of fibres by specially designed needles or barbs) is a major bonding method of nonwovens in its own right and it is frequently the only consolidation route for nonwovens ranging from medical/hygienic disposables to spun-laid geotextiles.

The appearance of a relatively new group of products such as split-films and extruded meshes and nets presents a further borderline between nonwovens and related technologies (in this case, plastics). For the purpose of this International Standard, products would be regarded as nonwovens if they meet the requirements of the core definition above and where their main structural element can be regarded as fibrous, however derived.

Viscose is not considered to be a chemically digested vegetable fibre.

The United States government has voted to disapprove the ISO/DIS 9092 definition for nonwovens because it does not include some materials which are considered to be nonwovens in the United States, the definition is unnecessarily complicated and the definition of "paper" is dependent upon nonspecified test methods for aspect ratio, density, and fibrous content composition. The government recommends the adoption of the definition presently stated in ASTM Designation D1117-80 (2) which is given as:

Fabric, nonwoven, n., a textile structure produced by bonding or interlocking of fibers, or both, accomplished by mechanical, chemical, thermal, or solvent means, and combinations thereof. The term does not include paper or fabrics that are woven, knotted, or tufted.

The *Dictionary of Paper* (3) states that a nonwoven fabric is:

A clothlike material made of fibers longer than those normally used in papermaking which, instead of being woven on a loom, is formed by felting on a fine mesh screen from an air or water suspension with or without binders.

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*"Specific products already described as papers in ISO committees and related commissions would be regarded accordingly for the applications about which the decision was made (for example aramid for insulation application). The method(s) to be adopted for classifying certain nonwovens made by the air-laid paper process are currently under review."

The problem with this definition is that it excludes nonwovens such as carded, spunbonded, and some other nonwoven materials.

The definition that I use for nonwovens is:

Fabric-like structures consisting of fibers that are bonded by some way or other.

Perhaps this definition is not descriptive enough, but at least it is simple. Because it is so simple, it of course would never be accepted. This leads us back to the same conclusion, and that is, we need an acceptable definition for nonwovens. What may be worse, the word nonwovens is not even mentioned in Webster's dictionary (4) or *Encyclopaedia Britannica* (5)

Nonwovens may be produced by either a dry process or a wet process. There is no difficulty in classifying whether dry laid products are nonwovens. However, wet-laid nonwovens present an entirely different and perplexing problem. For example, how much textile-like fibers must be added to a paper slurry, before the end product can be called a nonwoven. Is it 1%, 10%, 51%, or some other value? The federal government is presently wrestling with this problem. Why are they interested? They are interested because imported products from abroad usually have some form of import duty depending on the product. If the product cannot be defined, then the amount of tax can not be established. The government simply can not stand this dilemma, and it is believed that they are about to adopt

the policy that any wet-laid product containing more than 20% of a textile-like fiber will be considered to be a nonwoven. However, if the amount of textile-like fiber is less than 20%, then the problem of what to call the material may still persist.

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Other than those in the business, nonwovens for the most part are not even known to exist. For example in the homes, how many individuals are aware that they are used for furnace air filters, carpet underlay and indoor-outdoor carpeting, lamp shades, mattress ticking and bedding, furniture construction, drapery bunting, wall paper, book covers and dust cloths.

When you drive to work, who would think that the tires, air and oil filters, carpeting and kick panels, firewall sound absorbers, head liners, hood EMI filters, and structural members may be a nonwoven and even the roads that you are driving on may have been stabilized with or had a covering consisting of a nonwoven to prevent reflective cracking?

After arriving at work, how many people know that the computer disc they are using has a nonwoven to act as a bearing surface and a means of cleaning the disk so that the disk will not "crash?" Who realizes that the office copier or laser printer has a nonwoven wipe to make it function properly? Also how many individuals know that the word processor, computer or even the radio that they listen to has a printed circuit board that may be made with a nonwoven? Your favorite coffee brew may have been strained through a nonwoven filter or the tea that you drank was filtered with a nonwoven filter making up the tea bag. The carpet tiles that you are standing on may be reinforced with a nonwoven and even the roof that keeps the building dry, may be composed of a nonwoven.

We could cite the use of nonwovens in apparel, industry, agriculture, the hospital, and other areas. However it would only serve to further reflect what is already obvious. That is, that most people are not aware of what a nonwoven is, even if they are using it or looking at it. Truly, nonwovens are rarely known or seen.

Literature cited

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