SPUNLACING - TODAY'S ADVANTAGE

Don B. Gillespie
Fleissner, Inc.
Alfred Watzl
Fleissner Gmbh

From 1987 to 1995, the annual production of spunlaced (hydroentangles) products increased by a factor of more than three times. To date, however, production consists almost exclusively of nonwovens with a maximum weight of 120 gsm. When using higher operating pressures of up to 350 bar, however, it is also possible to needle webs of up to 400 gsm with the spunlacing technology.

Mechanical bonding of heavy weight webs by spunlacing has been an area which **FLEISSNER** has pioneered and several patents are held in this respect as well as new application possibilities envisioned.

The mechanical needling process uses needle boards on which a large number of needles with barbs are arranged side by side and which move up and down so that the individual fibers in the web passing underneath are entangles and the fabric is bonded.

With spunlacing technology, the nonwoven fibrous web structure from the web forming line is passed continuously through the process line where rows of water nozzles are arranges above the web. In this process of mechanical bonding, very fine high pressure water jets entangle the fibers. The individual fibers are entangles and inter-twined with one another to form a very soft textile type product with high tensile strength. Water jet pressures of up to 400 bar are available today with the **FLEISSNER** designed jet manifolds.

Nonwoven webs made of 100% natural fibers can be produced and speeds of up to 250 m.min are achievable. The standard mechanical needling process by needle looms is not suitable for lighter weight webs and speeds as outlined above are not possible. With the spunlacing process, web weights between 20 and 400 gsm are possible.

Among the developments already achieved are the successful bonding of staple fibers and pulp, and of spun bonded nonwovens fibers. In addition, aperturing by spunlacing to create patterned webs has been carried out. The splitting of specially designed fibers at high pressure have also been tested to produce products with unique qualities.

The pre-compacting unit on our design maintains the MD/CD ratio produced by the web forming equipment. After pre-needling, the compacting wire mesh moves upwards and transports the pre-wetted web under the next jet head. The jet head used for pre-wetting is of the same design as the bonding jet heads. This ensures absolute uniform wetting and subsequently regular bonding. The design of the pre-compacting belt has proven to be very successful and is an important component of the **AQUAJET** line. As is generally known, the webs are mostly bonded by water jets acting alternately from both sides. In most cases, the drum represents the first stage of the spunlacing line and the second stage can be either a needling belt or another drum.

Research has shown that an alternating treatment of both web sides with water jets, i.e., not only a treatment from one side and then the other, but a succession of treatments alternating from both sides, yielded a higher web strength and a lower specific energy consumption. Hence, it is possible to operate with fewer jet heads, i.e., smaller water quantity, while achieving even better web qualities. This is especially important with the heavier webs which have recently become of interest to the spunlacing process.

The decision to use a multistage spunlacing system and whether or not it might be useful depends on various criteria such as web weight, fiber size, desired strength range, production speed, web support, investment amount, etc.

As early as 1979, the influence of alternating processing steps on fiber webs was studied at the Research Institute for Textile Technology (FIFT). A high strength value was shown to result from alternating water jet treatments. In the experiment, there were four treatment changes. The result is illustrated in **FIGURE 1**.

Further work was carried out in 1993-94 under the direction of Dr. Hilmar Fuchs and the results showed that for each combination of the respective, influencing parameters, there is an optimum number of nozzle passages and treatment changes.

In this work, as well as research carried out in the **FLEISSNER** R & D facility, the unfavorable effects on heavier webs of several jet heads arranges one after the other, i.e., continuous treatment of only one web side, have been identified. These include reduces strength and less regular surface structure of the web.

The correlation between web strength and treatment changes are not typical only of bonding by means of hydroentanglement. With mechanical needling on regular needle looms, there is also a direct correlation between strength and the number of passes. **(SEE FIGURE 2)**

In the entangling process, the intensity of the energy depends on the water pressure. With the energy density being in proportion to pressure, changing the pressure has a considerable impact upon the entanglement effect. The

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entanglement effect, in turn, influences the stability, surface integrity and the elasticity of the non-woven.

The highest increase in stability occurs at the beginning of water needling. Stability, however, results from maximum entanglement, i.e., energy supply. The energy can be supplied to both sides of the web with the multi-stage entangling design as outlined above.

An important criterion of an installation's economic efficiency is the specific spunlacing energy, which equals the water jet power (KW) related to the fiber throughput (KG/HR). total energy consumption with the **FLEISSNER AQUAJET** process is minimized by the following measures:

- Optimization of the jet head by a computer-simulated flow calculation
- Selection of the wire mesh most suitable for the material and a corresponding drum jacket of microporous structure
- Use of individual pumps for each jet head, thus throttling is avoided, which is very energy-consuming
- Availability of one-step, two-step or multi-step installations based on the desired web-range (gsm) and product characteristics.

Summarizing, the **AQUAJET** process, as compared to the installations of former generations, is operating with energy savings of 50-70%.

Despite a higher energy consumption for hydroentanglement than, for example, for mechanical needling, considerably higher strength values can be achieved for the same web weight. This allows production of lighter weight webs with a considerable reduction in fiber and binder, thus reducing the total cost of such products.

TABLE 1 shows that the higher energy cost of the spunlace process is more than outweighed by the lower raw material cost compared to mechanical needling. In some cases, this also applies to comparisons with other bonding processes.

The following orders of magnitude can be given as standard values for the hydraulic energy transferred to the web:

- 0.03-0.1 kwh/kg fiber (0.014-0.045 kwh/lb fiber) for applications where the required strengths are obtained at low pressures, e.g., cotton pads, combinations of two webs into a sandwich structure.
- Approximately 0.2-0.4 kwh/kg fiber (0.09-0.18 kwh/lb fiber) for typical web productions
- Approximately 0.65-0.80 kwh/kg fiber (0.29-0.36 kwh/lb fiber) for heavy webs, e.g., coating substrates of 350 gsm

Today's spunlacing technology with the **FLEISSNER AQUAJET** design is definitely a viable and versatile process to consider for product lines in the marketplace where the application demands are rigid.

Table 1. Example:

Spunlaced		Mechanically Needled	
Weight:	100 G/sm	Weight:	180 G/sm
Strength M/c:	250n/236n	Strength M/c:	120n/120n
Fiber Cost:	0.450 Dm/sm	Fiber Cost:	0.81 Dm/sm
Energy Cost: (Spunlacing and Drying)	0.028 Dm/sm	Energy Cost:	0.01 Dm/sm
Total Cost:	0.478 Dm/sm	Total Cost:	0.82 Dm/sm

This Example Shows That the Higher Energy Cost of the Spunlace Process Does Not Have Any Influence When Compared with the Raw Material Cost. In Some Cases, this Also Applies to the Comparisons with Other Bonding Processes.

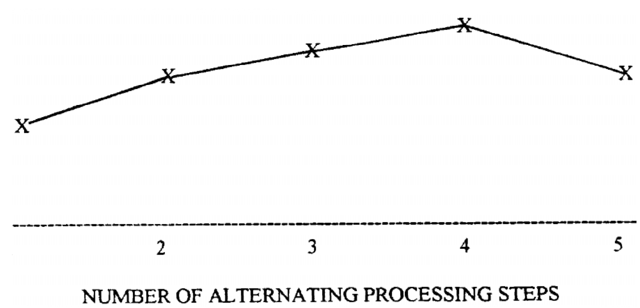

Figure 1. Nonwoven Strengths as a function of the number of alternating processing steps in the spunlace process.

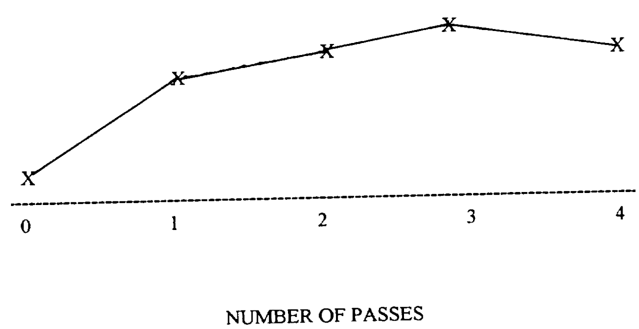

Figure 2. Nonwoven strengths as a function of the number of passes in the mechanical needling process.