

Nonwoven finishing with fluorocarbons – a challenge for machine manufacturers and auxiliaries suppliers

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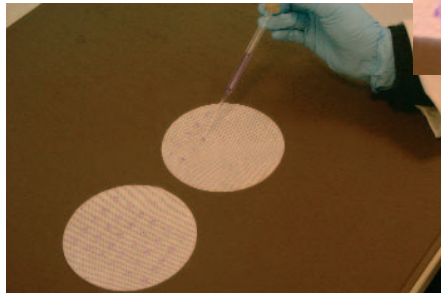
Introduction

Innovative problem solutions for the finishing of nonwovens are a challenge for both machine manufacturers as well as for auxiliaries suppliers. It therefore appears logical to exchange experience in research and development and to explore possibilities for new products and processes jointly. It is under this aspect that the enterprises Zschimmer & Schwarz, Lahnstein, (www.zschimmer-schwarz.de) and Küsters, Krefeld, (www.kuesters.com) have decided on undertaking a joint development for the application of fluorocarbons on nonwovens. The objective being to optimise the process technology and product properties. Results of this cooperation are described in the following article.

Fluorocarbons are, besides others, used for medical articles, such as clothing and covering for operations made of PP spunbonded web. In addition to water, blood and alcohol repellency antistatic properties are also required. These requirements, however, stand in contradiction to each other. Only by way of fluorocarbons systems specially developed for this purpose is it possible to manufacture products with excellent repellency and, at the same time, sufficient antistatic properties. Here, the selection of the liquor application system is of decisive importance. In a joint series of trials between Zschimmer & Schwarz and Küsters comparisons between traditional spraying systems versus padder application and the level of effectiveness were evaluated. The optimisation of the drying/condensation process is currently still being studied. A report on these results will be given at a later stage.

Requirement profile

The special requirement on the product to be finished is that hydrophobicity and antistatic properties be obtained simultaneously. In most cases an untreated PP spunbonded web already meets the required hydrophobic values. These can be further improved by the application of fluorocarbons, which primarily serve the purpose of obtaining alcohol repellency. The critical factor in the required combination is antistatics, because all antistatic agents are more or less hydrophilic. With Lertisan HE 101 Zschimmer & Schwarz have developed a product that, in addition to fluoro-



Alcohol repellency

carbons, contains a special antistatic agent that does not influence water and alcohol repellent properties negatively and, in this way, fully meets the requirements for medical applications.

For fluorocarbons to optimally develop their repellent properties they must form a closed, even film on the substrate and then be subjected to an effective drying process to enable the alignment of the fluorocarbons molecules. Contamination of the substrate causes drastic loss of effectiveness. In the in-line production of spunbonded web for medical applications there are also high speed requirements to the application system and to drying.

Comparison of application systems

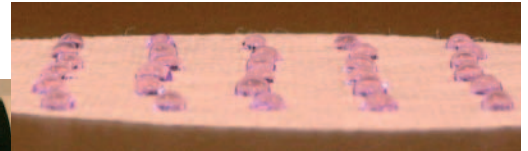
Already in the run-up to the series of trials the use of a KissRoll Applicator for the application of fluorocarbons was ruled out, as fluorocarbons have only an inadequate wetting property (product distribution on the application roll) and do not possess any special affinity to PP nonwovens. This is why for fluorocarbons finishing forced application is the only possibility.

Spraying application

The main advantages of spraying application are surely the comparatively short drying times as the liquor pick up normally is in the area of 20%, independent of the basis weight. System-related disadvantages are, however, the pure surface application and the uneven product distribution – especially at high fabric speeds due to strong air flow on the fabric path. Normally spraying is one-sided, so that effects are only generated on one side. This can lead to problems when manufacturing garments. In principle a double-sided spraying is possible, the main advantage of low moisture application is then, however, lost.

Padder application

In padder impregnation the nonwoven is fully penetrated and the product application takes



place evenly over the whole fabric width. The result is a closed film whereby the effect is of a very high level. A disadvantage is the comparatively high liquor pick up (usually 90-120%) which demands a respective drying path. The amount of liquor pick up varies, depending on speed, line force, roll combination and basis weight.

Conducting and evaluating the trial series

The trials were conducted with a PP spunbond (basis weight 45 g/m²). Different emulsion concentrations with Lertisan HE 101 were produced, in order to represent oil pick up within the range of 0.8%.

Spraying trials

For the spraying trials two different emulsion concentrations were chosen. With a 5% emulsion a liquor pick up 20% was realised, which is close to practice. In an additional test the emulsion was thinned down to 1% so that with a liquor pick up of approximately 100% a direct comparison to a padder process could be achieved.

Padder trials

Initially the influence of line force on the liquor pick up with various roll combinations was investigated. (See diagram Line Force)

As expected, the liquor pick up is reduced at higher line force. In addition, the selection of special roll coverings contributes towards reducing the hitherto usual moisture level by 30-40%, at a corresponding line force.

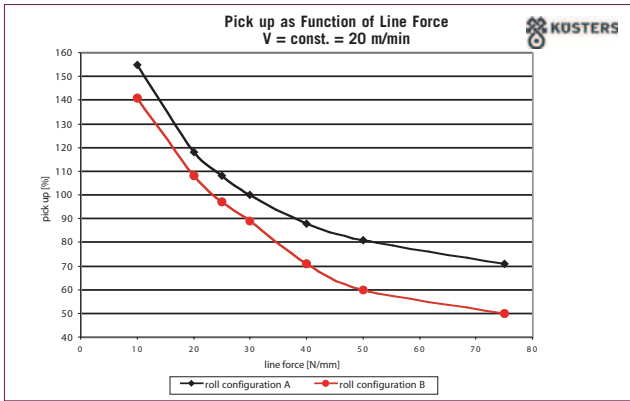
After trials with different roll combinations the measurement of the repellent properties did not show any significant variations when the amount of fluorocarbon applied remained unchanged.

In a second series of trials the focus was on the influence of speed on the liquor pick up. (See diagram Line Speed)

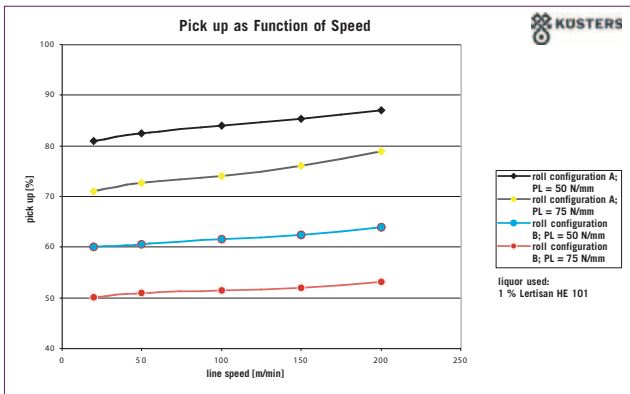
Evaluation of the trials

To verify the level of effects various evaluation methods were used with regard to antistatic and repellency of alcohol, oil and water of the finished nonwovens. To establish the antistatic properties, the transition resistance was determined in accordance with DIN 54 345 with a Mahlo Texto Meter.

The alcohol and oil repellency was judged by way of a drop test. Here, in the case of alcohol re-



Line Force



Line Speed

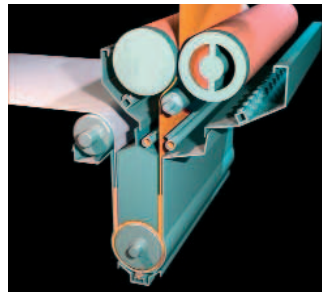
pellency, 30 drops of a 70:30 mixture of Isopropanol and water are applied to the nonwoven test sample. After 1, 5, 7 and 10 minutes the drops that are still on the test sample are counted. Likewise, in the case of oil repellency, a similar test is conducted with paraffin of low viscosity. To establish the water repellent properties the water column according to the Edana Directive 120.1-80 was determined.

Results

To compare the two application technologies samples with the same oil application were prepared. (See table right)

Conclusion

In order to achieve an optimal finishing result, the padder application is indispensable. The trials conducted show that when approximately the



S-Roll Padder

same amount of fluorocarbon is applied the alcohol repellency of samples produced by spraying application in particular is significantly lower in comparison to samples finished with a padder. It is evident that by spraying application no closed fluorocarbon film can be achieved, even if working with higher moisture application for better product distribution. An increase of the fluorocarbon application is no answer, as with an increasing application the concentration of the antistatic agent in the finishing product is raised, which leads to poorer alcohol repellency. By adequate roll coverings in combination with high line force modern S-Roll Padder systems reduce the usual moisture level of 90 to 120% liquor pick up to a range of 50 to 80%.

Comparison	Lertisan HE 101					Raw Material
Viscosity [mPas]	14					
Active matter [%]	46					
Nonwoven material:	PP-Spunbonded 45 g/m ²					
Application system:	S-Roll Padder		Spraying system			
Speed [m/min]	20		20			
Drying	10 min 135°C		10 min 135°C			
Oil pick up [%]	approx. 0.8	approx. 0.8	approx. 0.8	approx. 0.8	approx. 2.0	
Roll combination	A	B	-	-	-	
Solution concentration [%]	1	2	5	1	5	
Pick up [%]	approx. 80	approx. 50	approx. 20	approx. 100	approx. 40	
Hydrostatic head [mm]	400	413	383	387	350	390
Alcohol repellency*	30/30/30/30	30/30/30/30	9/8/6/6	17/12/10/10	0/0/0/0	0/0/0/0
Oil repellency*	30/30/30/30	30/30/30/30	30/30/30/30	30/30/30/30	5/0/0/0	0/0/0/0
Transition resistance [W]	4x10 ⁹	8x10 ⁹	>10 ¹⁰	6x10 ¹⁰	4x10 ⁸	>10 ¹⁰

*Number of remaining drops of 30 after 1, 5, 7 and 10 minutes

Innovative Problemlösungen für die Vliesveredlung stellen eine Herausforderung für Maschinenbauer und Präparationshersteller dar. In einem gemeinsamen Entwicklungsprojekt der Firmen Zschimmer & Schwarz, Lahnstein, und Küsters, Krefeld, wurde die Applikation von Fluorcarbonen auf PP Spinnvlies für medizinische Artikel untersucht. Hier werden neben der Wasser-, Blut- und Alkoholabweisung auch antistatische Eigenschaften gefordert. Diese Anforderungen stehen jedoch im Widerspruch zueinander. Mit Lertisan HE 101 hat Zschimmer & Schwarz ein Fluorcarbon-Produkt mit einem

speziellen Antistatikum entwickelt, das die abweisenden Eigenschaften nicht negativ beeinflusst. Bereits im Vorfeld wurde der Einsatz eines KissRoll Applicators zum Antragen von Fluorcarbonen aufgrund der unzureichenden Produktverteilung auf der Antragswalze ausgeschlossen. Zur Fluorcarbon-Ausrüstung bietet sich deshalb nur die Zwangsapplikation an. In der vorliegenden Untersuchung wurde der Sprühauftrag mit einem S-Roll Padder hinsichtlich des erzielbaren Effektniveaus verglichen. Die durchgeführten Versuche ergaben, dass optimale Ausrüstungseffekte nur mit der Foulard-Applikation erreicht werden können.

Durch Sprühauftrag ist kein geschlossener Fluorcarbon-Film erzielbar, der für ein optimales Effektniveau zwingend erforderlich ist. Bei annähernd gleicher Fluorcarbon-Auflage fällt insbesondere die Alkoholabweisung der durch Sprühauftrag hergestellten Muster deutlich geringer aus im Vergleich zu Mustern, die im S-Roll Padder ausgerüstet wurden. Durch geeignete Walzenbeläge in Kombination mit hohem Liniendruck erzielen moderne S-Roll Padder Systeme optimale Effekte und können die Flottenaufnahme auf einen Bereich von 50 – 80 % reduzieren.