Studies on liquid absorbency behaviour of nonwoven web

Candidate: Ms Rupali (2017 TTZ 8351)

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ABSTRACT

Cellulosic fibres are commonly used in many absorbent products. These products are generally highly porous in nature. Though high porosity leads to better absorbing capacity, however, too porous structures are highly fragile and can easily collapse during absorption process, due to surface tension of the liquid. Deformation also leads to changes in porosity, nature of pores and pore size. A tight structure on the contrary can resist collapse being structurally rigid. The structural rigidity is dependent on fibre fineness, initial modulus, and degree of mechanical bonding between the fibres. The absorbency characteristics of nonwoven fabrics made from very coarse and fine cotton fibres preferred under high and low needle punch densities, have been investigated for two areal densities. It has been seen that the absorption capacity rises phenomenally once the porosity crosses the value of 0.97. The estimated and actual absorption capacities and retention% values have been found to be well correlated. All nonwovens have shown the tendency to collapse laterally during absorption process, leading to lowering of absorption capacity especially loose and nonwovens made of fine fibres (3 micronaire). On an average, the webs made from coarser fibres showed better absorption capacity, rate, and retention than those made from fine fibres, irrespective of process parameters or external pressure. However, the coarse fibre web showed better liquid retention%.

Subsequently, a series of nonwoven webs were prepared using blending technique by super absorbent fibres (SAF): cotton and Kapok: cotton. For SAF: Cotton blended nonwoven, three types

of nonwoven structures, viz. mono-component (100 % cotton) and two types of SAF: cotton mixed, bi-component, i.e., one homogeneous mixture (random) and the other layered structure, were prepared. All the nonwoven webs were evaluated for absorption capacity and retention. Surprisingly, the absorption capacity of homogenously mixed improved marginally compared to mono-component (100 % cotton web). The presence of SAF, however, exceptionally increases the liquid retention% of the blended structure. Amongst all the structures, the retention% in the case of layered structure was found to be superior. The correlation coefficient between absorption capacities estimated based on the rule of the mixture and actual capacity was found to be 0.90. Similarly, the liquid absorption and retention characteristics of Kapok: cotton blended webs were investigated. The morphological characteristics of raw, scoured, and rewetted Kapok fibre was first studied. The Kapok fibre lumen was found to be collapsed after scouring. However, it regained its shape after re-wetting. Absorption capacity, rate and retention were found to be exceptionally well at 50:50 Kapok: cotton ratios in the nonwoven web. The result also shows that with respect to 100% cotton sample, the capacity, rate, and retention increased by 26.1%, 300%, and 13.5%, respectively, by adding 50% Kapok with cotton.

Other than that, a liquid acquisition-cum-distribution top layer was also developed using spun lace polyester-viscose (30:70) fabric. The one side of the fabric layer is coated with fluorocarbon using the spray coating process to make it hydrophobic. The coating process parameters, spraying distance (distance between spraying nozzle and fabric), finish concentration, and partial coating are varied to determine the optimum combination. The effectiveness of the coating process has been assessed by measuring contact angle, moisture management, and rewet tests. In the end, three incontinence prototypes were developed using: (1) 100% cotton (2) Kapok: cotton, and (3) SAF: cotton, as an absorbent core sandwich between single phased hydrophobic top layer and barrier sheet. Their performance was also evaluated based on rewet test, absorbency test and posture test. It was found the Kapok: cotton incontinence developed product have better absorbency, retention under load and works well under varying condition simulating the real time scenario.