THE EFFECT OF SUPERHYDROPHOBIC AND SUPERHYDROPHILIC COATINGS ON HYGIENE GRADE NONWOVENS ON KEY PERFORMANCE PROPERTIES

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INTRODUCTION

Disposable hygienic products are often composed of multi layers of nonwovens. The leg cuff nonwoven in baby diapers is used to prevent leakage and made of spun and meltblown fibers (SMS configuration). Whereas topsheet is responsible to transfer the urine to the diaper core and include only spun fibers (SSS). The goal of this project is to show whether absorption and barrier properties of topsheet and leg cuff can be improved, respectively.

ABSTRACT

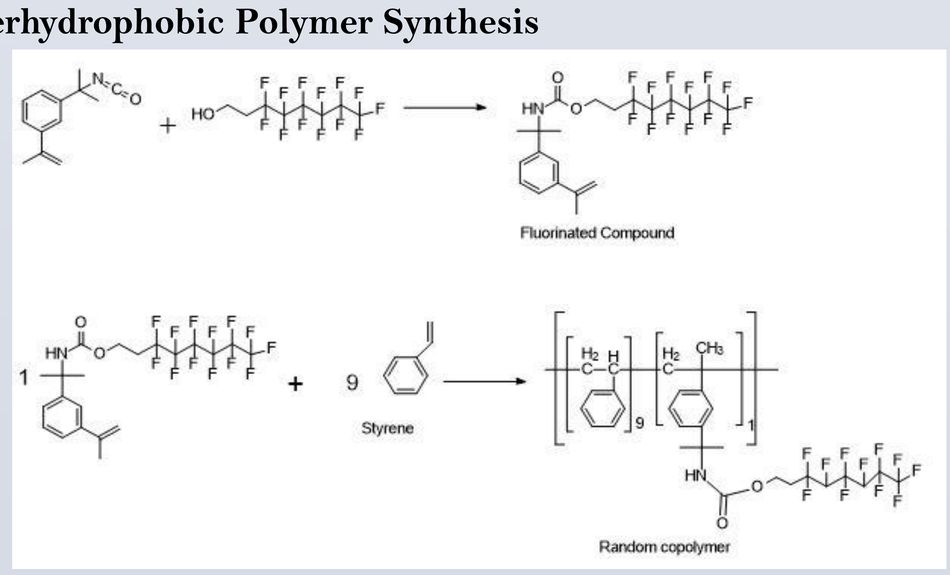
The project focuses on the investigation of novel superhydrophobic and superhydrophilic coatings on the performance of nonwoven materials used in hygiene products, specifically baby diapers and adult diapers. Superhydrophobic coatings were fabricated via the electrospinning of a custom designed perfluoroalkyl bearing polymer, whereas superhydrophilic coatings were obtained from an anionically modified silane compound.

The structure of coated surfaces was analyzed by Scanning Electron Microscopy (SEM) and water contact angle measurements, whereas liquid barrier or absorption behaviors were determined by strike-through, rewet and hydrostatic head pressure tests. Subsequently, such properties were compared with existing reference materials provided by Hayat Kimya. Hydrophobically coated nonwoven surfaces showed water contact angle well above 150^0. Strike through test shows that coated SSS surfaces can compete with SMS nonwoven in terms of water absorbance performance.

Preliminary results show that hydrophilic coatings produced and applied on SSS nonwoven in Sabancı University absorb water in strike through tests in ~5 seconds, while reference materials provided by Hayat Kimya have absorbance time of ~55 seconds for virgin SSS and ~4 seconds for hydrophilic coated SSS.

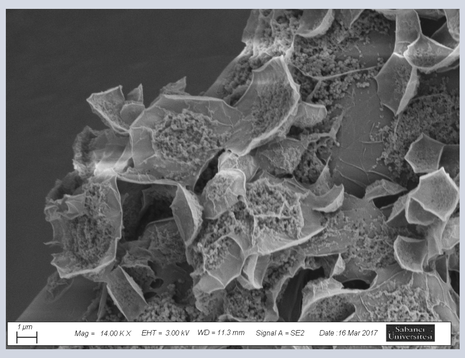
PROJECT DETAILS

Superhydrophobic Polymer Synthesis

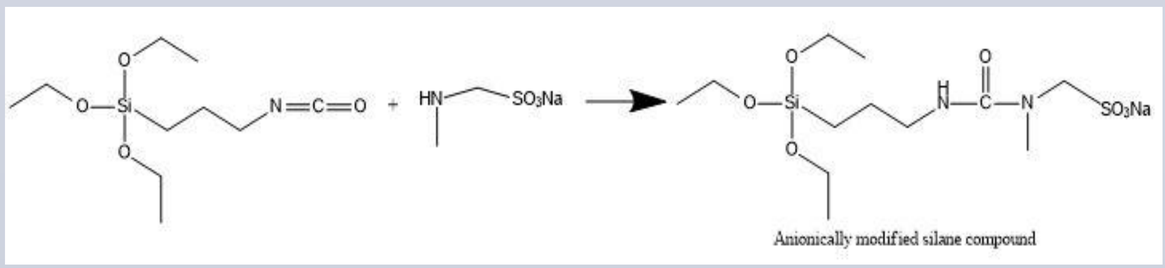


1 wt% of superhydrophobic polymer was dissolved in THF-DMF binary system, electrosprayed on SSS nonwoven with different duration and rate parameters.

Binary solvent system used in electrospraying to achieve dual scale roughness on surfaces and scanning electron microscopy images show formation of micrometer and nanometer sized beads.



Hydrophilic Compound Synthesis



RESULTS

Sample	Rate (µl/min)	Duration (hour)	WCA (Average*)	Strike Through Test (s) Water Absorbance (%)**
SSS non-treated			133,3±9,3	55,8±38,7s
SMS			142,2±5,6	142,2±5,6 s
N1 (on SSS)	50	1	150,9±7,3	0,70%
N2 (on SSS)	75	1	153,9±8,3	1,40%
N3 (on SSS)	25	1	157,4±5,4	39,70%
N4 (on SSS)	50	1,5	151,7±5,7	1,00%
N5 (on SSS)	50	2	151,7±6,8	6,80%
N6 (on SSS)	25	4	154,4±5,9	0,39%
N7 (on SSS)	25	3	152,5±5,9	0,50%
N8 (on SSS)	25	8	155,6±8,0	0,42%
N9 (on SSS)	25	2 hour front	154,0±5,7	32,40%
		2 hour back	158,0±6,9	2,20%
N10 (on SMS)	25	4	159,1±7,2	16,80%

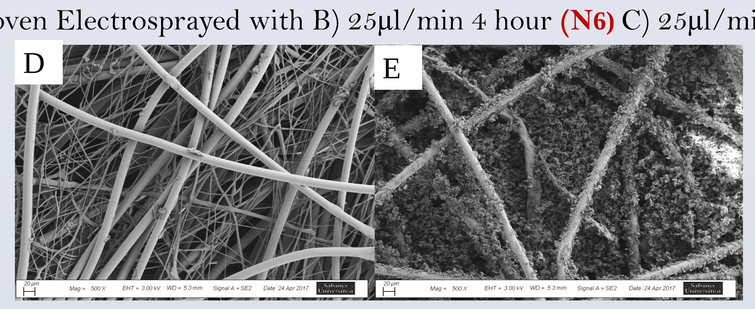
*Average of 8 measurements
* * Tests still in progress.

Sample	Concentration	Strike Through (s)
SSS-hydrophilic treated		3,51±0,87 s
S1 (on SSS)	1 wt% (in water)	4,70± 0,55
S2 (on SSS)	5 wt% (in water)	6,62 ± 2,72
S3 (on SSS)	10 wt% (in water)	4,72 ± 0,57

For the **strike through test**, 5 ml of 0,9% NaCl solution was poured into the apparatus and absorbance time was determined. If, the sample does not absorb whole of the water after 1 hour, percentage of absorbed water was calculated.

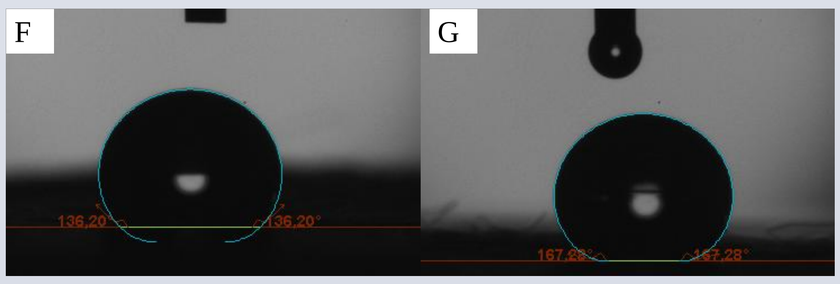
SEM IMAGES

A) SSS nonwoven Electrosprayed with B) 25µl/min 4 hour **(N6)** C) 25µl/min 8hour **(N8)**



D) SMS nonwoven E) Electrosprayed with 25µl/min 4 hour on SMS **(N10)**

WATER CONTACT ANGLE ANALYSIS



F) SSS nonwoven G)75µl/min, 1hour **(N2)**

CONCLUSION

SEM images show that superhydrophobic coatings were successfully formed on nonwoven surfaces. , whereas contact angle measurement and preliminary strike-through test results prove that they have promising superhydrophobic behavior to replace SMS. The average water contact angle of superhydrophobically coated SSS is 15% higher than the virgin SSS nonwoven. While the virgin SSS nonwoven absorbs the liquid in ~55 seconds, superhydrophobically coated SSS samples do not absorb in 1 hour.

Hydrophilic coatings produced and applied on SSS nonwoven surfaces absorb water within ~5 seconds. Eventhough, early results are promising, they are not yet able to compete with reference hydrophilic material, further investigation is in progress.

ACKNOWLEDGEMENTS

We thank Prof. Yusuf Menceloğlu, Asst. Prof. Serkan Ünal, Asst. Prof. Fevzi Ç. Cebeci, E. Billur Seviniş Özbulut and Ayse Durmuş for their guidance and support and Hayat Kimya for their collabaration.

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Simsek, E., Acatay, K., & Menceloglu, Y. Z. (2012). Dual Scale Roughness Driven Perfectly Hydrophobic Surfaces Prepared by Electrospraying a Polymer in Good Solvent–Poor Solvent Systems. *Langmuir*, *28*(40), 14192-14201.