MELTBLOWN NONWOVEN TEXTILE FILTERS

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ABSTRACT

Melt blowing is a kind of microfiber nonwoven production process which uses thermoplastic polymers to attenuate the melt filaments with the aid of high-velocity air. Polypropylene (PP) is the most widely used polymer for this process. Melt blowing has become an important industrial technique in nonwovens because of its ability to produce materials suitable for many applications including the filtration media. Nonwoven filters can be used in various applications such as surgical face mask filter media, automotive filters, liquid and gaseous filtration, clean room filters and others. This paper makes an overwiev of meltblown nonwoven filters; technologies used, properties, effects of some production parameters on filtration efficiency, application areas.

Key Words: meltblown nonwovens, filtration, microfiber nonwovens, textile filters (10 pt)

1. INTRODUCTION

The filtration can be defined as “the process od separation of dispersed particles from a dispersing fluid (gas or liquid) by the help of porous medium”. [1]

One of the fastest growing segments in the nonwovens industry, filtration is characterised by dozens of end use areas and applications. Nonwovens can be engineered very precisely to meet exacting specifications and stringent regulatory requirements for the filtration of air, liquid, bacteria, dust, gas and a myriad of other areas. Nonwovens have evolved from simply replacing other forms of media, such as paper, cloth, glass and carbon to becoming the media of choice for filtration [2]

Alone or in combination with other methods, meltblowing is a widely used technology for the production of nonwoven filters.

Melt blowing is a kind of microfiber nonwoven production process which uses thermoplastic polymers to attenuate the melt filaments with the aid of high-velocity air. Polypropylene (PP) is the most widely used polymer for this process, since it is relatively inexpensive and versatile enough to produce a wide range of products. Other polymers such as polyethylene (PE), poly(ethylene terephthalate) (PET), poly(butylene terephthalate) (PBT), polystyrene, polyurethane (PUR), and polyamide (PA) can also be used for the production of melt blown nonwovens [3,4,5,6].

Meltblown microfibers generally have diameters in the range of 2 to 4 μm, although they may be as small as 0.1 μm and as large as 10 to 15 μm. Differences between meltblown nonwoven fabrics and other nonwoven fabrics, such as degree of softness, cover or opacity, and porosity can generally be traced to differences in filament size [6,7,8].

Melt blowing has become an important industrial technique in nonwovens because of its ability to produce materials suitable for filtration media, thermal insulators, battery separators, oil absorbents, medical area, miscellaneous applications, apparel area, wipes, and many laminate applications. [3,4,6]

The aim of this study is to make an overwiev of meltblown nonwoven filters; technologies used, effects of some production parameters on filtration efficiency, application areas and basing on the results of previous research emphasize the effects of various production parameters, such as die-to-collector distance (DCD), collector drum speed, collector vacuum, die air pressure, extruder pressure and extruder speed on the filtration efficiency of meltblown nonwovens.

2. TEXTILE FILTERS

Nonwoven nanofibre filtration media is now filling the micro-filtration performance gap that had existed in the past, offering benefits such as enhanced air quality, reduced energy cost, and longer service life. Nonwovens are ideal in filtration applications where strength of extremely high temperatures are required but other advantages of nonwovens include low cost, ease of strikethrough and increased efficiency
The advantages of using nonwovens for filtration are [2]:

- Removal of a wide range of contaminants from water (bacteria, viruses, metals, minerals etc.)
- Uniform structure
- Tear- and puncture-resistance
- Chemical resistance
- High retention capacities
- High air permeability
- Excellent abrasion resistance
- Flame retardancy
- Absorption of fats and oils
- High level of flow capacity
- High tensile strength

Various technologies namely airlaid, electrospun, meltblown, needlepunch, spunbond, spunlace, thermobonded, wetlaid can be used in the production of nonwoven filters [2].

Filtration is a very large filed for textiles, including versatile end uses. Application areas of nonwoven filters according to EDANA are [2]:

- **Automotive filtration:** Engine Air, Oil, Fuel, Cabin Air
- **Air filtration:** HVAC - industrial heating, ventilation and air conditioning; Industrial Filtration; Consumer Products (vacuum cleaners, cooker hoods, PCs …); Clean Rooms
- **Liquid filtration:** Food & Beverage (milk, wine, tea ..); Pharmaceutical/Medical; Water; Blood; Hydraulic
- **Speciality filtration:** Antimicrobial; Biopharmaceutical; Dust; Odour

3. EFFECTS OF SOME PRODUCTION PARAMETERS ON THE EFFICIENCY OF MELTBLOWN FILTERS

Filtration efficiency of a nonwoven material is related to its physical properties. Results of the studies previously conducted in this field have shown that physical properties of the meltblown textile filters are affected by various production parameters including air temperature, polymer/die temperature, die to collector distance (DCD), collector speed, polymer throughput, air throughput, die hole size and air angle. Both polymer throughput and air flow rate control the final fiber diameter, fiber entanglement, basis weight and the attenuating zone. Polymer/die and air temperatures combined with air flow rate affect the uniformity, shot formation which can be described as large globules of nonfibrous polymer larger in diameter than fibers in webs, rope and fly formation, fabric appearance and touch [8,9].

Some results obtained from previous studies are given below:

- Filtration efficiency is increased by increasing thickness. Thickness of polypropylene meltblown nonwovens are effected mostly by the drum speed and the collector vacuum. An increase in the drum speed and an increase in the vacuum causes a decrease in the thickness. Thicker surfaces are obtained with lower collector drum speeds and lover vacuum values. [6,8]
- The basis weight of the polypropylene meltblown nonwovens are mostly influenced by the die air pressure, collector drum speed and collector vacuum. Filtration efficiency increases with increasing basis weight. The basis weight increases with decreasing collector drum speed, increasing die air pressure and increasing extruder speed. The collector vacuum has a significant effect on basis weight; when the vacuum increases the basis weight also increases. The effect of extruder pressure on the basis weight is not statistically significant. [6,8]
- Air permeability is an important property for meltblown nonwovens, that effect their performance in many applications especially in filtration. Air permeability decreases with increasing thickness and basis weight, due to a denser structure. The air permeability property of the meltblown nonwovens are influenced by the die air pressure, the collector drum speed, the collector vacuum and extruder pressure. The air permeability increases with increasing die air pressure, collector drum speed and decreasing vacuum. The air permeability decreases with the increasing extruder pressure. It was also observed that air permeability decreased with increasing fibre diameter. [6,8]
- Fibre diameter of meltblown nonwovens is a very important parameter for filtration. Lower fibre diameters adres to a better filtrarion efficiency, due to increased surface area. Fibre diameter decreases with increasing extruder speed. [6,8]

4. CONCLUSION

Polypropylene meltblown nonwovens can be used in various application areas including filtration. The results of previous studies regarding meltblown nonwoven filters have shown that production parameters have significant effects on physical properties and thus the filtration efficiency. The properties of such materials should be investigated deeply for different applications.

3. REFERENCES

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