APPLICATION OF NONWOVENS FOR WATER FILTRATION

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Abstract: *Filter fabric during the present has seen a substancial demand across the world due to increase in water pollution and technical awareness continual research activity enables manufacturer for more and more innovative solutions, to create **c**loths with special weave, to manufacture customized products, in order to satisfy complete demand of outsourcing market wide range of filter fabrics – available in different fibers satisfy the requirements of different industries. According to the sources the demand is going to break the records in coming years. Focusing on filter fabric as a main; its fabric manufacturing technique, selection criteria, filtration efficiency, filter performance and its various applications in brief.*

Keywords: *Effluent, Non-woven, water filter.*

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1. INTRODUCTION:

Water filtration is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. The goal is to produce safe and clean water for a specific purpose. Most of the water is filtered for human drinking purpose, but water filtration may also be carried out a variety of other purposes, including meeting the requirements of medical, pharmacological, chemical and industrial applications. In general, the methods used include physical processes such as filtration, sedimentation, and distillation, biological processes such as slow sand filters or biologically active carbon, chemical processes such as flocculation, chlorination and the use of electromagnetic radiations such as ultraviolet light. The filtration process of water may reduce the concentration of particulate matter including suspendedparticles, parasites, bacteria, algae, viruses, fungi and a range of dissolved and particulate material derived from the surfaces that water may have made contact with after falling as rain [1].

Nonwoven fabrics described as a random fibrous web formed by either mechanical, wet or air laid means and having interconnecting open area throughout the cross-section are able to remove a percentage of particulate from liquid or gaseous fluids streams flowing through it. Hence they find applications in filtration. Generally manufacturers' of non woven fabrics supply filtration media having mean flow ratings ranging from from 1 to 500 micron. Micron ratings depend significantly on the test procedure by which the manufacturer rates the media. Fabrics having micron ratings below 10-15 micron must be calendared, in order to achieve the finer micron ratings. But certain wet laid glass fabrics are exception for this. With the micron pore rating, dirt holding capacity, flow rates and differential pressure data are also considered.

2. WHAT IS FILTRATION?

Filtration is defined as the mechanical or physical operation used for the separation of solids from fluids (liquids or gases) by interposing a medium through which only the fluid can pass."

Oversize solids in the fluid are retained, but the separation is not complete as solids are contaminated with some fluid and filtrate contains fine particles (depending on the pore size and filter thickness). Filtration is also used for some biological processes, especially in water treatment and sewage treatments wherein undesirable constituents are removed by absorption into a biological film grown on or in the filter medium [1].

Filtration differs from sieving, where separation occurs at a single perforated layer. In sieving, particles that are too big to pass through the holes of the sieve are retained. In filtration, a multilayer lattice retains those particles that are unable to follow the tortuous channels of the filter. Oversize particles may form a cake layer on top of the filter and may also block the filter lattice, preventing the fluid phase from crossing the filter. Commercially, the term filter is applied to membraneswhere the separation lattice is so thin that the surface becomes the main zone of particle separation, even though these products might be described as sieves.

3.CLASSIFICATION OF FILTRATION

a. Dry filtration

i. Gas filtration
ii. Air filtration

b. Wet filtration

The three main types of wet filtration:

i. Surface Filtration
ii. Depth Filtration
iii. Cake Formation

i. Surface filtration

All particles which are bigger than pores are captured on the flat filter surface. The typical example are spunbond filters. Thus, for these filters, the pores distribution and permeability are important properties. Surface filtration is common for liquid filtration. Surface filters are described in subject “High funcional textiles“.

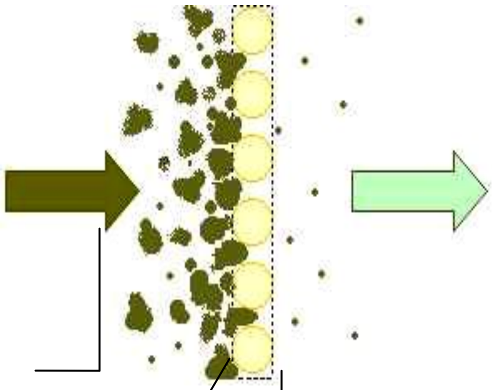

Figure 1: Surface filtration

ii. Depth Filtration:

Depth filters are able to capture particles that are too small to be sieved out as in flat filtration. Particles, that are smaller than the distances between fibers, penetrate into the fiber structure. Filtered particles are captured in terms of the filtration mechanisms. This type of filtration process is important for the most of filter applications.

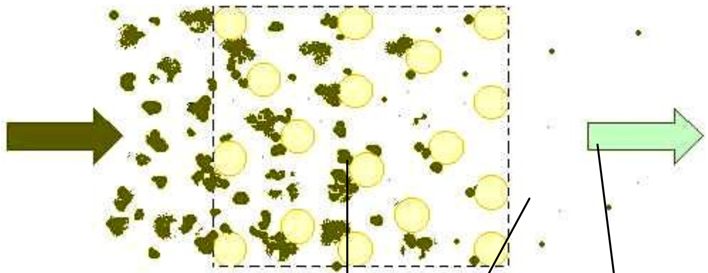

Figure 2: Depth filtration

iii. Cake Filtration

A filtercake is formed by the substances that are retained on a filter. The filter cake grows in the course of filtration, becomes "thicker" as particulate matter is being retained. With increasing layer thickness, the flow resistance of the filter cake increases. After a certain time of use, the filter cake has to be removed from the filter by back flushing. If this is not accomplished, the filtration is disrupted because of increase the flow resistance due to the filter cake.

Figure 3: Cake filtration

With the increase in time the thickness of the cake increases, as more solids are filtered. This results in a corresponding increase of the pressure resistance across the cake.

If the cake is incompressible the pressure resistance increases proportionally to the cake thickness.However, since most of the cakes are compressible the pressure across the cake typically increases, even faster than the cake build-up [2].

Depending on the process of separation, filtration is classified as:

1. Particle filtration

Particle filtration is the separation of particles having size above 10 microns. These can be filtered out easily without any usage of micro porous membrane.

2. Microfiltration

Contaminants from a fluid (liquid & gas) can be removed by using microfiltration by passing liquid through a micro porous membrane. In a typical microfiltration membrane, pore size ranges from 0.1 to 10 microns (μm). There is no need to apply pressure in microfiltration process.

3. Ultra-filtration

An ultra-filtration filter has a pore size around 0.01 micron. A microfiltration filter has a pore size around 0.1 micron, so when water undergoes microfiltration, many microorganisms are removed, but viruses can pass through. Ultra-filtration would remove these larger particles, and may remove some viruses as well. Neither microfiltration nor ultra-filtration can remove dissolved substances unless they are first adsorbed (with activated carbon) or coagulated (with alum or iron salt).

4. Nano filtration

A nano filtration filter has a pore size around 0.001 micron. Nano filtration removes most of the organic molecules, nearly all viruses, most of the natural organic matter and a range of salts. Nano filtration removes divalent ions, which make water hard. Hence, nano filtration is often used to soften hard water.

5. Reverse Osmosis

Reverse osmosis filters have a pore size around 0.0001 micron. After water passes through a reverse osmosis filter, it is essentially a pure water. In addition to removing all organic molecules and viruses, reverse osmosis also removes most of the minerals that are present in the water. Reverse osmosis removes monovalent ions, which means that it desalinates the water.

Osmosis occurs when a semi-permeable membrane separates two salt solutions of different concentrations. The water will migrate from the weaker solution to the stronger solution, until the two solutions are of the same concentration, because the semi-permeable membrane allows the water to pass through, but not the salt.

In reverse osmosis, the two solutions are still separated by a semi-permeable membrane, but pressure is applied to reverse the natural flow of the water. This forces the water to move from the more concentrated solution to the weaker. Thus, the contaminants end up on one side of the semi-permeable membrane and the pure water is on the other side [3].

4. Mechanisms of filtration:

Filtration is carried out by following mechanisms

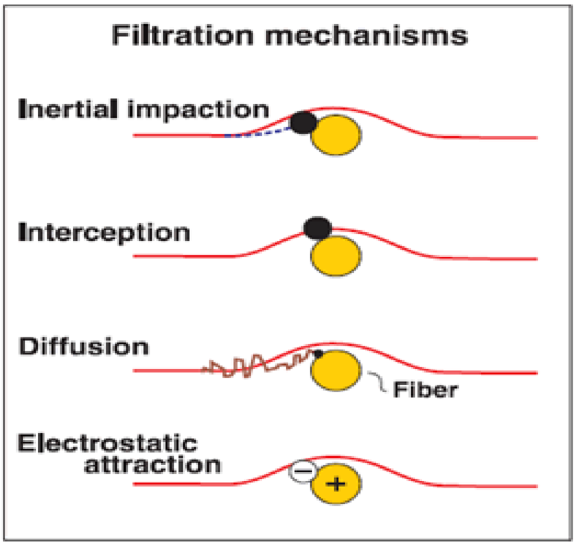

Figure 4: Filtration Mechanisms

i. Inertial Impaction

Inertia works on large, heavy particles suspended in the flow stream. These particles are heavier than the fluid surrounding them. As the fluid changes direction to enter the fiber space, the particle continues in a straight line and collides with the media fibers where it is trapped and held.

ii. Interception

Direct interception works on particles in the midrange size that are not quite large enough to have inertia and not small enough to diffuse within the flow stream. These mid-sized particles follow the flow stream as it bends through the fiber spaces. Interception occurs when particles small enough to follow the airstream around the fiber but are intercepted by the fiber due to the dimension of the particle radii being larger than the distance between the fiber and airstream path the particle is following. The particle is held to the fiber by a molecular surface attraction known as Van der Waals' Forces.

iii. Diffusion

Diffusion, also referred to as Super Interception, occurs on sub-micron particles which have sufficiently low mass so that air molecules, which are continually in motion and bombarding the particles, cause the particle to travel in an erratic path. This motion increases the chance of the particle coming in contact with the fiber. The smaller the particle, the stronger the effect. Small particles are not held in place by the viscous fluid and diffuse within the flow stream. As the particles traverse the flow stream, they collide with the fiber and are collected.

iv. Electrostatic attraction

Electrostatic filtration is an extremely effective method for removing dust, smoke, and other small particles from air over a particle size range from about 10 to 0.01 microns. The principle involved is that of passing the air through an ionizer screen where electrons colliding with air molecules generate positive ions which adhere to dust and other small particles present, giving them a positive charge. The charged dust particles then enter a region filled with closely spaced parallel metal plates alternatively charged with positive and negative voltages of the order of 6000 volts DC. Positive plates repel the charged particles which are attracted by and retained on the negative plates by electrostatic forces, further supplemented by intermolecular forces, causing the dust to agglomerate [4, 5].

5. Liquid Filtration

Liquid filtration is the separation of solid matter and fluids.

Factors influencing filtration process are:

5.1. Turbidity of fluid dispersion

- particle concentration
- particle size, surface characteristics, degree of dispersion of the solid matter
- temperature
- viscosity and density of fluid and solid matter

5.2. Pressure difference on the two sides of the filter lamina

- dependent on the flow velocity and the permeability of the filter or the filter cake
- influence the structure up to the filter cake[7].

Water FiltrationSystems

The general treatment of drinking water takes place in several steps to remove dissolved and suspended solids. The treatment processes may include processes such as flocculation, sedimentation, and media filtration to remove colloidal and suspended solids; ion exchange, carbon adsorption, and membrane processes to remove dissolved solids; and a disinfection step often achieved by chlorination, ozonation, and ultraviolet radiation.

Filtration systems can be divided into several categories depending on the type of the media used for filtration and the size of the contaminants to be removed from water. Following are recent advancements that relate to different types of filtration systems used for drinking water treatment.

i. Media Filtration

Media Filtration is the most effective method for removal of suspended organic and inorganic solids from water.Media filters remove suspended solids from water. Media filters are often constructed using one or more layers of sand, gravel, anthracite, and other inert media. As the water moves through filter media, suspended particles are trapped within the filter. The top layer removes organic compounds, which contribute to taste and odor. Most particles pass through surface layers but are trapped in the pore spaces and/or adhere to particle surfaces within the media.

ii. Membrane Filtration

Membrane filters or “membranes” are microporous plastic films with specific pore size ratings. Also known as screen, sieve or microporous filters, membranes retain particles or microorganisms larger than their pore size, primarily by surface capture.

Membrane filtration is a general term used for a number of different separation processes. The membrane acts as a filter that allows water to flow through it, removing suspended solids and other substances. Membrane process can be pressure driven or dependent on electrical potential gradients, concentration gradients, or other driving forces.

Pressure-driven membrane processes include microfiltration (MF) and ultra-filtration (UF), nano-filtration (NF) and reverse osmosis (RO). These all are membrane filtration techniques. In all cases, the size of the pores has to be carefully calculated to exclude undesirable particles, and the size of the membrane has to be designed for optimal operating efficiency. Membranes are also prone to clogging as the pores slowly fill with trapped particles, which means that the system must provide accommodations for easy cleaning and maintenance so that it can be kept in good working order.

iii. Filtration Cartridges

Filter cartridges are also used in medical devices such as dialysis systems. Dialysis is a systems used for patients requiring hemodialysis or peritoneal dialysis which involves pumping a large volume of dialysate through a dialyzing device. In these filters, the used dialysate is generally discarded after a single pass through the filter.Cartridge filters have pore sizes are larger than 1.0 mm.

iv. Hybrid Filtration Systems

Technologies which combine coarse filtration with membrane filtration processes offer ease of operation and optimize the benefits of both types of filtration systems. The main characteristic of this system is that underneath the primary space there is an accessory space that has an essentially smaller cross-section to keep the filter surrounded by unclean water [8].

6. FIBERS USED FOR FILTER FABRIC CONSTRUCTION

i. Polypropylene:

Polypropylene is mostly used for wet filtration. However, it is sensitive to oxidising agents such as chlorine, nitric acid etc. This fiber is widely used in woven and nonwoven structure in wet filtration due to its resistance to chemical degradation. This fiber is creep prone due to low glass transition temperature. The production is ecological and waste-free. It is resistance to insects, mildews and rot and having good washability and quick drying properties [9].

The polypropylene non woven filter cloth has the lowest temperature resistance up to 80^{o}C, With its reasonable price and excellent hydrolysis resistant, anti-acid, anti-alkali, anti-abrasion, etc.It's mainly applied to the low temperature and high humid conditions.

ii. Polytetrafluoroethylene:

It is virtually resistant to all chemicals having a maximum service temperature of 280°C. PTFE membranes are an important building block for designing safe and effective solutions to challenging medical filtration and separation problems. It is biocompatible, biostable, and hydrophobic used for manufacturing of filter bags. The fabrics made of this fiber are hard and expensive to produce. There could also be problems with stretching and/or shrinking during filtration operation [10].

The main disadvantages of PTFE are

- low melting point
- low thermal conductivity
- relatively low load carrying capacity

Because of the disadvantages polytetrafluoroethylene is used in light low speed applications.

iii. Polyester:

Polyester is widely used fiber in filtration because of its strength, relatively high temperature resistance. The disadvantages of polyester for filter application are low resistance to alkalis, acids and steam. Polyester is mainly used for manufacturing filter bags of fine quality.

These filter bags are used in various industries to trap the dust particles. PET is strong, abrasion resistant, can work up to 150°C and has good resistance to common acids, solvents and oxidizing agents.

However, polyester's only real weakness is a tendency to get hydrolyzed at elevated temperatures.

iv. Acrylic

Acrylic non woven filter cloth can withstand temperatures up to 130^{o}C. Having anti-acid, anti-alkali properties.

v. PPS (Ryton)

PPS (Ryton) non woven Filter clothcan work upto temperature range of 190^{o}C-210^{o}C having anti-acid, anti-alkali, hydrolysis resistant properties. It finds application in waste incinerator, electric station boiler, industry boiler and so on.

vi. Glass Fiber

Glass fiber non woven needle felt have high temperature resistance upto 240^{o}C- 260^{o}C. It has low price compared to other fibers that can withstand high tempertaures. It has low shrinkage rate, high intensity, but it is crisp, which is applied in chemistry.

vii. Polyamide

Polyamide non woven needle felt with following characteristics:

High temperature resistance 260- 300^{o}C. Good chemistry resistance, good air permeability, high filtration efficiency, but the price is high. It is mostly applied in cement kiln.

viii. PTFE

PTFE coated non woven needle felt adopt PTFE fiber, formed by three- dimensional needled. PTFE fiber is a linear macromolecular structure, which has strong stability. Wear résistance, chemical stability, temperature resistance is particularly prominent, and it is widely used in steel, power, waste incineration flue gas filtration and other harsh environment.

7. FABRIC CONSTRUCTION

Three basic types of construction are found in filter fabric i.e. woven fabrics, nonwoven and knitted structures.

i. Woven Fabrics

By virtue of its greater number of pores, it permits higher filtration velocities, greater laminar flow and therefore a lower pressure drop across the fabric. By using a combination of continuous filament warp and staple-fiber weft yarns, preferably in a satin weave for a smoother surface and greater flexibility, an ideal compromise is possible. In this case, the filtration efficiency can be further enhanced by subjecting the weft side to a mechanical raising treatment [11].

ii. Knitted Fabrics

Filter fabrics are used in the chemical industry such as petrol, oil and air filters in motor vehicles, or as fluff-filters in washing machines that are produced on various Tricot and Raschel machines. The type of machine, gauge, and yarns used depend on the density of the fabric and the resistance required against filtering liquids. The advantages of warp knitted filter fabrics is an optimal porosity of the artery walls and minimize bleeding their water permeability ranging from 400-650 cm3 / cm2 min-1 [12].

iii. Nonwoven Fabrics

There is wide-spread application of nonwovens' in various filtration applications including geoengineering. The critical pore size corresponds to the diameter of nominally spherical solid particle that will pass through this pore. This minimum pore is not identical throughout the nonwoven. Hence, pore size variation is also considered. Higher the number of fiber strata and consequently the greater the thickness of nonwoven, higher the probability of encountering the pores of minimum size at least once throughout the on woven. The homogeneity of the nonwoven is all the lower the variation between lowest and highest pore diameters. Needled / felted nonwoven filters are generally thick and the spun bonded fabrics are quite thin but provide better filtration.

There are five different types of nonwoven processes that are used to make filtration media. The most widely used is Needlepunch followed by Wetlaid, Meltblown, Spunbond and Carded/Other [2].

Needlepunch:

Needlepunch media is 3D (it has length, width & depth), it is very good for trapping contaminants on both the surface and the interior. In liquid filtration, needlepunched medias are used for filtering paints, cleaning intake water, sewage effluent, etc. Worldwide, the needle punching industry enjoys one of greatest successes of any textile related process. The needle punching industry around the world is a very exciting and diverse trade involving either natural or synthetic fibers. Needlepunched nonwoven is manufactured by mechanically orienting and interlocking the fibers of a spunbonded or carded web. This mechanical interlocking is achieved with thousands of barbed felting needles repeatedly passing into and out of web [13].

Wetlaid:

In some respect, wetlaid nonwovens are similar to paper. Swimming pool filters, coolant oil filters, HEPA (High Efficiency Particulate Air) filters and coffee filters are examples of wetlaid media uses.

***Meltblown**:*

Meltblown technology allows uniform, micro porous webs to be formed from very fine filaments. It is most often found in end uses that require the filtering of very fine particles. Particulates such as smoke, asbestos, lead dust and other airborne contaminants can be filtered through meltblown. It is used extensively in respirators; for face masks; automotive cabin filters as well as a filter to catch the fine dust particles.

***Spunbonded**:*

Spunbonded filter media made of polyester, polypropylene or nylon are used as both air &liquid media to produce a filter fabric.

Carded & Other:

Use of resin bonded or thermal bonded carded media, airlaid pulp and a small sector of spunlaced media which was used in filtering milk, cooking oils, coolant oil filters and in face masks has largely been replaced by the newer, more cost effective nonwoven processes above.

Special Characteristics:

Depending upon the form and construction of the nonwoven filter media, nonwoven fabrics filtration characteristics and capabilities vary widely. Wide pore size distribution of nonwoven fabrics can be both an asset and limit use to prefiltration or non-precision filtration. However, special manufacturing or post-processing such as calendering can sometimes overcome this. One interesting fact, that few in the filtration industry realize, is that these specialty processed nonwovens do not have a much wider pore size distribution than microporous membranes which are rated above 1 micron. In the 1 to 20 micron mean flow pore range, the costs of nonwovens are much less than membranes and the dirt holding capacity is generally far superior. However, their flow rate suffers due to lower void volume than membranes. All of which reinforces the fact that filter design engineers make their media selections based on performance trade-offs. Nonwoven fabrics have thicker cross-sections and bulk compared to membranes, wire cloth and monofilament fabrics. Thus, nonwovens fabrics are the material of choice when large quantities of particulate loading, long-life or where general clarification of a liquid or gas stream is required. Nonwoven fabrics are relatively inexpensive compared to most other media. Only filter aids have lower cost per pound, but generally do not compete in the same applications as nonwoven fabrics [2, 14].

8. REQUIRED PARAMETERS FOR WATER FILTER FABRIC:

i. Fabric Parameters

Filtration is the process of separation of one kind of substance from another kind. Thus filtration can be defined as the separation of suspended solid particles from gas, liquid or even solid. The medium used to distinguish between these two types of material is called the filter and the separated material can be designated as filtrate. In general, filtration can have two possible objectives:

i. To eliminate the contaminant particles so as to recover dispersing fluid.
ii. To recover solid particles eliminating the dispersing fluid.

From the phenomena point of view, the filtration process can be characterized by various parameters.

Drop in Pressure Δp: Drop in pressure through a filter is defined by the following expression:

$$\Delta p = P1 - P2$$

Where P1 is the pressure before the filtration and P2 is the pressure after the filtration.

Filter Efficiency E: The filter efficiency is defined as a ratio between the quantity of particles retained in the filter and the number of dispersed particles found in the suspension.

Filter Penetration P: This parameter related to the previous one through the following expression:**E + P = 1**

And represents the number of particles that manage to pass through the filter, in the relation to those existing in the suspension before getting through the filter.

Filter Capacity Q: Filter capacity is defined by the amount of particles deposited in it [expressed in g or kg] and that accumulated before a drop in pressure begins. The capacity of a filter must be specified for each particles size.

Cleaning Efficiency: It is the ratio of dust retained by fabric after cleaning to total dust deposited expressed in percentage.

Degree of Filtration: This parameter defines the ratio between a certain size particles that enters the filter and the particles of the same size that leave the filter. It is evident that a textile fabric or a non woven fabric construction is a porous medium. Whatever may be the nature of the textile construction, the solid matrix that almost totally encloses the pore size is the textile fiber. The agglomeration of the fibers of different length and fineness, more or less oriented to form the said solid matrix.

ii. Pore size distribution

Pore size and its distribution play an important role in water permeability characteristics. When the depth of needle penetration is varied in the needle punching process, keeping the fabric weight constant, it may result in different structural arrangement of fibers in nonwoven fabrics, subsequently affecting the pore size and their distribution. During the process of needle punching some the medium pores are converted into smaller pores and larger pores converted into medium pores due to the entanglement action of the needle. These types of pores mainly help in retaining the impurities in the fluid flowing, apart from allowing the fluid to pass through fabric [15-17].

iii. Water permeability

The water permeabilitydecreases as the depth of penetration of needles increases during the needle punching process. This may be due to variation in the pore characteristics of nonwoven fabric. The water permeability decreased as the feed rate of fibers increases during the needle punching process [17-19].

iv. Air permeability

Air permeability is defined as "the rate of flow through a material under a different pressure."

Porosity is defined as "the total volume of void space contained within the boundaries of a material."

Filter fabric density has significant influence on air permeability than either thickness or fiber size. Fabric weight and thickness were both inversely proportional to air permeability [15, 18,19].

v. Water -to-cloth ratio

The term filtration velocity water to cloth ratio can be used interchangeably. The formula used for the filtration velocity is

$$V = \frac{A}{AC}$$

Where,

V= Filtration velocity

Q= Volumetric water flow rate

AC= Area of cloth filter

The water to cloth ratio is the ratio of water filtered in cubic feet per minute to the area of filtering media in sq. feet. Filter fabric have lowest water to cloth ratio for getting the maximum filtration efficiency. The ratio of filtering time to cleaning time is the measure of percent of time the filter are performing [20].

9. COMPARISON OF WOVEN AND NONWOVEN FILTER FABRIC

Woven filter fabric	**Nonwoven filter Fabric**
Expensive in manufacturing	Low-cost in manufacturing
High strength fabric	Low strength fabric
Two dimensional structure	Three dimensional structure
Low permeability	High permeability
Chance of yarn slippage	No chance of yarn slippage
Only surface filtration occurs	In-depth and surface filtration occurs due to its construction and thickness
Separation predominantly by sieve mechanism	Separation by impact, interception, diffusion, electrostatic charge mechanism

Only those particles are retained which are large than the interstices between threads	Pores may be greater than the particles to be retained and yet produce very high efficiency of separation

10. ADVANTAGES:

There are many advantages of nonwoven fabrics, including their versatility, low cost and diverse functionality. The price-performance ratio is outstanding. Nonwoven fabrics are made from standard and many specialty inorganic and organic fibers including common wood pulp, cotton or rayon. Surprisingly, the growing use of soft, highly flexible, fine diameter and non-kinking stainless steel, nickel and titanium metal fibers now permits the use of needlefelted, air and wet-laid nonwoven fabrics which have extraordinary temperature, chemical and wide pH properties. The choices are almost endless. Resin bonded glass fiber liquid filter cartridges alsoprovide many excellent properties. Another advantage of nonwovens is the wide number of diverse processes fibers can be incorporated including needlefelt, air and wet laid, resin bonded et.al. In addition to media from discrete fibers, it is possible to simultaneously melt-spin a polymer fiber while forming a web construction without an intermediate fiber-forming step. Onestep processes typically include melt blown, spunbond and certain high-loft webs as discussed earlier. The direct web manufacturing method offers a cost advantage and very popular. These direct web processes produce fine and sometimes continuous filaments and in case of spun bond, a strong and non-shedding web which cannot be achieved by any other means for a comparable cost.

11. DISADVANTAGES:

Nonwoven fabrics like most filtration media, have disadvantages compared to other media choices, such as polymeric membranes, woven fabrics, metal media etc. No single media can or will ever satisfy every filtration requirement. In the case of nonwoven fabrics, the disadvantages are not so much the shortcomings of nonwovens, but the advantages other media. For example, membranes provide narrow pore size distribution, particularly below 1 micron mean flow pore. Monofilament fabrics and wire cloth offer strength and straight through holes for use in sifting and excellent sieving capabilities. All three of these are surface filters, a feature not easily achieved for nonwoven fabrics, because of the nature of the manufacturing processes and resultant constructions; at least, not yet. Many filtration and separation applications require stiffness, minimal flex, and rigidity or even low stretch as is the case of dewatering belts, which by their nature are less favorable to the use of nonwovens. All, which proves, that even with the tremendous growth of nonwoven fabrics in filtration, there are many unmet market opportunities for nonwoven fabric manufacturers to further expand their business.

12. MARKET:

Filtration market for nonwoven fabrics is broad. The largest single market for nonwovens, in both pounds and dollars, is baghouse filtration with needlefelted fabrics being the media of choice. Needlefelted fabrics also serve as a base substrate for a microporous membrane or porous coating in this application. Similar needlefelted fabric constructions are found in liquid filter bags in paint, chemical and general industrial applications. Meltblowns are widely used in liquid cartridges as prefilters or as final filters in many high-performance applications from pharmaceutical to the semiconductor industries. Membrane cartridge suppliers were the first to exploit the use of melt blown fabrics in the 1970.s and early 1980.s and the market continues to expand. Spunbonded fabrics are perhaps the most versatile, with filtration applications includingcoolant, cartridge pleat and membrane support. These fabrics supply strength, reasonable dirt holding capacity and in certain cases stiffness and lateral flux. Overall bonded fabrics consist of two or more dissimilar or contracting fibers which bond forming a bicomponent fabric and an especially stable web and minimal downstream fiber release; an important benefit when foreign contaminate in the filtrate is unacceptable. Many forms of nonwoven of both glass fabric and batting are used in air and liquid filtration including cartridges. Binder materials are often used to maintain fabric structure integrity and prevent fibers release downstream [21].

Filter clothes are used in almost all sectors of industry such as,

- agricultural area
- Chemical, dyestuff, textile, power fertilizer industry
- Pharmaceutical and cosmetic industry
- Mineral oil refineries
- Sewage disposal and effluent treatment plants
- Automotive industry

- Sugar, wine industry
- Dairy, starch, paper, cellulose industry
- Coating and paint industry
- Soap concentrating industry

CONCLUSION:

Seeing the polluted world and adulterations practices more and more in the coming days, demand for more or filter fabrics would generate and thus more technological advancement will happen in this field and thus will lead to higher filtration efficiency.For coming decades, filter fabric filtration will play a very important role in our day-to-day life; there is not a single type of fabric used in all the applications. The usage of the filter fabrics varies according to their end use.

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