Membranes for Textile and Garment Applications

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Stand number: A 39
Why use Membranes

• Membranes are used inside a garments
  – Typically they are laminated to the outer fabric with an adhesive

• They are used to make the garment:
  – Waterproof/ Windproof
    • Offer protect against the winter elements to keep you warm and dry
  – Breathable
    • so perspiration (sweat) can move through the membrane to the outside of the garment
    • allowing the user to feel comfortable
Why use Membranes

• A secondary use of membranes is that they can be used to provide other functionalities such as:

  – Protection against chemicals

  – Protection against blood borne pathogens and viruses
Why use Membranes

• They also need to be compliant with other requirements so they do not detract from the performance criteria of the garment e.g.

  – Flame resistance
  – Thermal heat resistance
  – Cold flex resistance
  – Durable
  – Stable to repeat washing or auto-clave
Types of membranes

• Hydrophilic – solid membrane

- Breathe through a process of absorption and migration driven by heat and high humidity.
- Chains of chemical groups which attract water vapour molecules.
- Water vapour molecules use the chains as stepping stones to travel from one site to the other.
Types of membranes

• Hydrophilic – solid membrane

• Examples include:
  • Polyurethane membranes – film formed by coating of a polymer solution on to a substrate
  • TPU membranes – film formed by extrusion of a melt polymer
  • Copolyester – block copolymer of polyester and polyether – film formed by extrusion of a melt polymer

• Issues in processing can be controlling the uniformity/ thickness of the film

• Advantages:
  • Light weight (10 g/m²)
  • Soft, flexible and quiet
Types of membranes

• Hydrophobic – microporous membrane

Breathes by allowing sweat in the form of water vapour molecules to pass through interconnecting micro-pores driven by heat and high humidity.

Passage of water droplets prevented by the micro-pores (that are 100 times smaller than a water droplet) and by surface tension effect due to hydrophobic character of the membrane i.e. repels water droplets.
Types of membranes

• Hydrophobic – microporous membrane

• Examples include:
  • Polyurethane membranes - produced by coagulation of polymer solution in water onto a carrier
  • Issues in processing can be controlling the structure to balance waterproofness versus breathability

• Advantages:
  • Dry feel for comfort
  • Good wash performance at high temperatures
  • Good cold flex properties
Types of membranes

- PTFE – based on a microporous membrane
  - Monolithic PTFE
  - Coated PTFE
    - Structure is coated with a solid polymer – typically a very breathable polyurethane.
Types of membranes

- Coated PTFE – microporous membrane

  Manufactured by:
  - Microporous PTFE manufactured by biaxial stretching of PTFE film/ PU coating applied as solution
  - Issues in manufacture can be uniformity of PTFE membrane/ delamination of PU coating from PTFE

  Advantages:
  - Excellent cold flex properties
  - Excellent heat resistant properties
Lamination of membranes

- Membranes can be laminated with adhesive to a vast range of textile substrates to form functional composites.
- Typically these laminates are 2 or 3 layers
- Adhesive weight needs to be optimised and should be applied in a discontinuous pattern (e.g. dots). This ensures higher breathability and softness/flexibility of the final laminate
- Some key manufacturing methods for lamination:
  - Gravure Roller
  - Rotary Screen
  - Heated Roller with joiner film
Lamination of membranes

- Gravure Roller – hot melt dot lamination

- Involves the application of an adhesive to a membrane or substrate applied in a dot pattern

- The adhesive is typically a melted reactive polyurethane adhesive.
Lamination of membranes

- Rotary Screen

- The adhesive is forced through a rotating roller with a series of small holes and applied the adhesive in a dot pattern

- The adhesive is typically a water based polymer paste which is typically a thermoplastic

A: Screen Mesh
B: Squeegee
C: Back Roller
Lamination of membranes

• Heated Roller with joiner film

• This method thermally bonds the fabric layer to the membrane with an adhesive film using a heated roller

• Can be used for membranes ideally with a discontinuous web adhesive.
Which is the right membrane to use

• Choice of membrane is dictated by:
  – Standards used in the fabric specification
  – Environment the garment will be used in
  – Additional protection requirements
  – Cost

• Typical tests in a standard for a laminate would include:
  – Waterproofness before and after washing
  – Breathability
  – Abrasion and flex resistance
  – Chemical or viral penetration resistance
  – Bond strength of membrane to fabric
Membranes for Different Market Segments

• Fire Fighters

• The key requirements are
  – Waterproof and breathable
  – Fire retardancy and thermal heat resistance
  – Chemical resistance
  – Blood borne pathogen and viral resistance

• Key Products
  – PTFE bicomponent FR membrane
  – Hydrophilic PU FR membrane
    (high temperature resistance)
Membranes for Different Market Segments

• **Medical Gowns and Drapes**

• The key requirements are
  – Waterproof and breathable
  – Blood borne pathogen and viral resistance
  – High temperature wash to kill viruses
  – Repeat wash cycle > 100 cycles

• **Key Products**
  – Hydrophobic Microporous PU membrane
Membranes for Different Market Segments

• **Military** – Combat forces

• The Key requirements are
  – Waterproof and breathable
  – Windproof
  – Resistance to prolonged exposure to extreme low temperature
  – Light weight and very durable

• Key products
  – PTFE bicomponent membrane
  – Microporous PU membrane
  – High breathe Hydrophilic membrane
Membranes for Different Market Segments

• Industrial

• The key requirements are
  – Waterproof and breathable
  – Cold weather performance
  – Oil / petroleum protection
  – Chemical protection
  – Cost

• Key products
  – Will depend on what level of protection is required
    • Weather protection
      – Hydrophilic membrane
      – Microporous PU membrane
    • Flame or chemical protection
      – Hydrophilic FR membrane
      – PTFE bicomponent FR membrane
PIL Membranes offers

- Hydrophilic membranes at 12, 25 and 40 microns
- Microporous membranes at 30, 45 and 55 microns
- Fire retarded membranes both hydrophilic and microporous
- High chemical resistant hydrophilic membranes
- PTFE bi components, standard, fire retarded and anti static