Arnitel® VT, a PFC free alternative for breathable membranes in outdoor clothing

Bad weather does not exist. Unfortunately, bad outdoor clothing does. The solution? Outdoor clothing that combines wearable comfort and optimal protection against rain, snow and low temperatures. DSM brings you a bright solution: Arnitel® VT.

Around the world, established outdoor clothing brands are looking for new solutions for garments that are waterproof, light, comfortable and breathable in one. At the same time, they want their materials and processes to have the lowest possible impact on the environment. Today's outdoor clothing can have it all, with ultrathin Arnitel VT membranes.

Arnitel VT can be processed in membranes that are high performing but just a few microns thick. The secret: the unique material structure and its monolithic nature make the Arnitel VT membrane flexible, elastic and comfortable. They leave the material "open" to moisture vapour yet "closed" to wind and water. Its high breathability makes sure body moisture is dealt with immediately. The monolithic structure assures 100% wind and waterproofness under all circumstances. Even when surface tension lowering liquids are applied like alcohol, fuel, soaps etc. optimal performance and comfort are still maintained.

Another advantage is its sustainability: Arnitel VT is extremely durable, made of 100% recyclable thermoplastic copolyester, and completely free of perfluorinated compound (PFC-free)

Comfort and performance

- high breathability
- extremely durable, long lasting performance
- excellent elasticity of 500%
- monolithic: waterproof, yet breathable
- lightweight: low density, ultra thin membranes
- excellent silky feel
- 100% recyclable (Polyester based chemistry)
- Free of Fluor (PFC free)

Performance: 100% waterproof, yet highly breathable

The Arnitel VT membranes are 100% wind and waterproof, while also allowing water vapor to pass through from within. This keeps the wearer dry and comfortable. Arnitel VT does not rely on perforations for breathability.

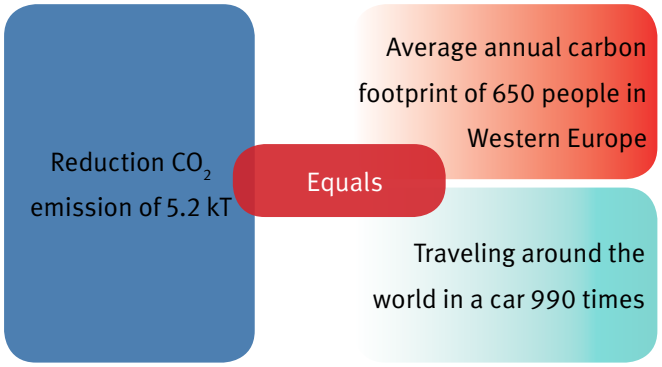
- Perforated membranes are more likely to compromise on waterproofness during washing or contact with liquids like alcohol or fuel. Perforations reduce the strength of the membrane, increasing the chances of ripping. They can also become clogged, causing the membrane to lose its breathability.
- Since Arnitel VT is not perforated, it acts as a barrier to not only liquids, but bacteria and viruses as well. This feature makes Arnitel VT an ideal and proven solution for surgical gowns that offer the highest level of protection.

Arnitel VT has been successfully used in clothing membranes for many years.

Sustainability: 100% recyclable and PFC free

Arnitel VT avoids using PFCs, the membranes are manufactured from a lower carbon footprint polymer and use less material than standard membranes based on perfluorinated polymers like PTFE (Polytetrafluoroethylene).

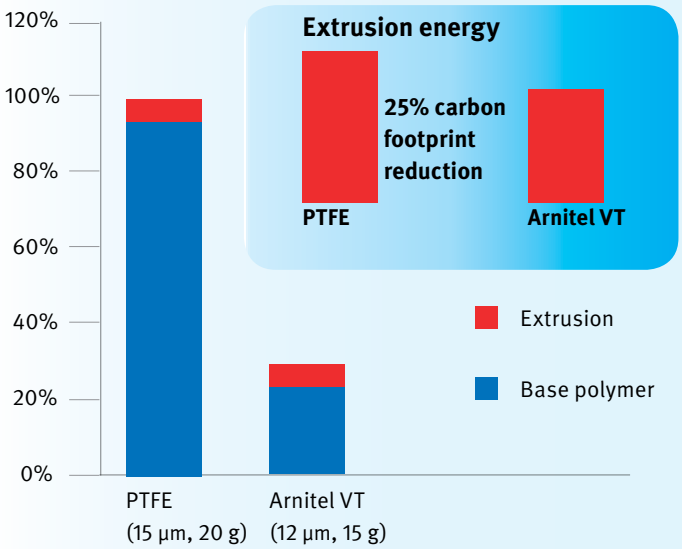
If everyone in the global breathable membrane market (estimated at 25 million m^2 per year) would use Arnitel VT, CO_2 emissions would be reduced by approximately 5.2 kT: the average annual carbon footprint of 650 people in Western Europe. That would be like traveling around the world in a car 990 times.



Membranes based on PTFE compared to Arnitel VT membranes

- Arnitel VT membranes don't involve the upstream emissions of hydrochlorofluorocarbons, or HCFCs (the greenhouse gases that deplete the ozone layer and are characterized by very high global warming potentials). The carbon footprint of these fluorinated polymers is about 215% higher: a large impact on climate change.
- Arnitel VT material is flexible, has a high stretch-recovery potential and is very breathable. Its thinner membranes mean it's more comfortable to wear. Typical Arnitel VT membranes for outdoor use are 25% lighter than similar PTFE membranes.
- All in all, this adds up to carbon footprint reduction of about 75%.

Carbon footprint comparison of breathable membranes
Functional unit 1m^2 membrane
Assessment method: IPCC 2007 GWP 100a
Sources: DSM primary data (Arnitel VT), Ecolnvent database (Extrusion), Gabi-PE (PTFE)



Environmental information and methodological background

Life cycle thinking at DSM

At DSM, sustainability lies at the heart of our business. That's why we focus on how our products and processes effect people, profit and the planet in their entire life cycle. We contribute to brighter living, with innovative solutions that create more value with less environmental impact. The ecological benefits can be created at any stage of product life cycle, from raw material through manufacturing and use to potential re-use and end-of-life disposal. To measure these benefits we use the Life Cycle Assessment (LCA) methodology.

Cradle-to-gate eco-footprint of Arnitel VT membranes

The cradle-to-gate eco-footprint values 1m^2 of Arnitel VT membrane at 12µm thick are provided in the table below divided in five impact categories. They can be used to assess the environmental impact of Arnitel VT membranes in footprinting studies further down the value chain.

Cradle-to-gate eco-footprint		
Impact category	**Unit**	**Value**
Global warming (GWP100)	g CO_2 eq	72
Ozone layer depletion (ODP)	µg CFC-11 eq	8
Photochemical oxidation	mg C_2H_4 eq	49
Acidification	g SO_2 eq	175
Eutrophication	g PO_4^{3-} eq	74

The data used for calculating the eco-footprint were retrieved from own DSM databases as well as external sources such as suppliers' data or publicly available databases. Therefore, due to internal and/or external developments in the databases, the footprint may change. This declaration has been prepared and issued on the basis of the information available at the issue date and our best knowledge and expertise.

Life Cycle Assessment (LCA) and footprinting

DSM has a well-established LCA competence center. We routinely apply ISO 14000 series standards for LCA and the Greenhouse Gas Protocol for carbon footprinting.

The Global Warming Potential (GWP) - or cabon footprint, expressed at CO_2 equivalents - was calculated using the Intergovernmental Panel on Climate Change Method (IPCC 2007 GWP 100a).

The eco-footprint was calculated using the methods prescribed by the International EPD® system. Details can be found at www.gednet.org.

Background processes

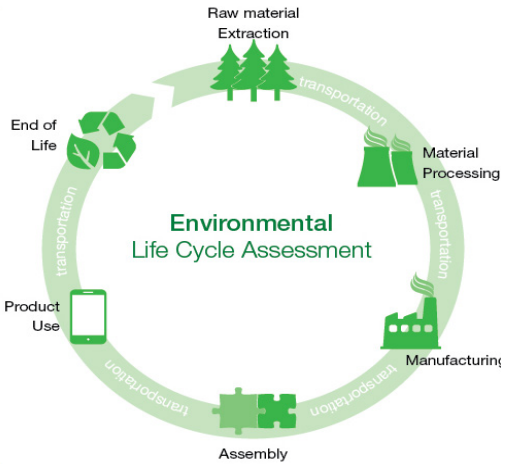
The data on the raw materials processes were based on background information from EcoInvent Database v2.01, from the Swiss Centre for Life Cycle Inventories. This source provides very high impacts for PTFE, related to the emissions of hydrochlorofluorocarbons in upstream processes. To avoid biasing the results, data from the PE-database were used instead. This resulted in a carbon footprint that is a factor 23 lower than reported in EcoInvent Database

Validity of results

The results for Arnitel VT membranes are rather accurate. They were based on primary data from the DSM polymerization process, combined with database models for the production of monomers. The results for PTFE membranes are less reliable, as models from different abatement technologies may produce materials with a wide range of footprints. The comparison was based on the PTFE model with the lowest available footprint.
Typical weight and thickness values for Arnitel VT and PTFE membranes of comparable performance and durability were found in "Microporous Polytetrafluoroethylene membrane and its fibre, by Xinmin Hao, et al., pp. 141, Chemical Industry Press, Beijing, China, 2011"and cross-checked with measurements performed in DSM laboratories and by a producer of laminated textile systems.

For this study we used:

- Arnitel VT membrane: membrane thickness = 12 µm; membrane weight = 15 g/m^2
- PTFE membrane: membrane thickness =15 µm; membrane weight = 20 g/m^2



Global PTFE breathable membranes production

The estimated production of global PTFE breathable membranes was based on information from the latest Frost and Sullivan report (Global Waterproof Breathable Textiles Market for Personal Protective Equipment (PPE) Applications—Outlook and Trends, Frost and Sullivan, 9833-39, February 2013).

Conversion to car kilometers

We converted savings to car kilometers by using a wheel-to-wheel emission factor of 132 g CO_2-eq/km for the average European car sold in 2012 as reported by the European Environment Agency (Monitoring CO_2 emissions from new passenger cars in the EU: summary of data for 2012, April 13, 2013). For round the world trips we used a conversion factor of 40,000 km/trip.

Conversion to people's footprint

For conversion to people's footprints, we used the value for Western European people for 2009 (8,000 kg CO_2-eq/capital) as a representative sample. This value was based on UNFCCC data available on the United Nations Millennium Goals Indicators website (mdgs.un.org).

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