УДК 637.42

MODERN INSULATION MATERIALS AND THEIR ADVANTAGES

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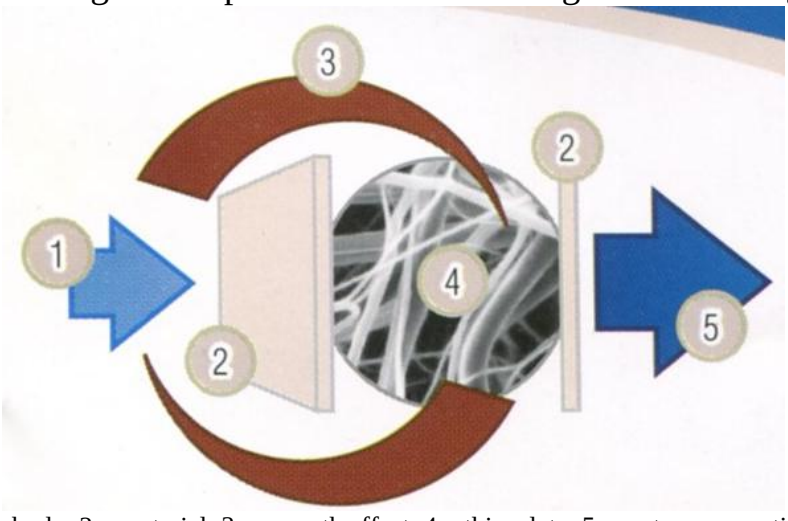
Nowadays multi-seasonal readymade garments are becoming increasingly popular. This trendy style of clothing is comprised of a variety of jackets, and well-insulated that coats made of artificial and mixed materials, which can be worn during two to three seasons of the year. This is made possible by different layering techniques, utilizing additional linings that can be easily unzipped or removed.

The external lining of multi-seasonal clothing is typically made of cotton, artificial or natural leather, or a combination of assorted materials. This external material can be connected or sewn together with the internal synthetic insulation. However, nowadays bulky synthetic insulation is being rapidly phased out and replaced by newly developed materials that are more compact with greater air control. Many of these new insulation materials employ technology that creates small permanent air pockets to prevent warmer air from escaping. These newer materials are made of special thin fibers, which are more durable for daily use and can withstand multiple washings.

In 1978, the National Aeronautics and Space Administration (NASA) requested that the American company 3M create a new and efficient technology for insulating astronaut space suits. The result was thinsulate, a piece of artwork exceptional at heat conservation. It is still regarded as one of the best insulation materials and can be compared to down in regards to its heat-retaining qualities (Fig. 1). The thinsulate consists of extra thin fibers which have demonstrated excellent results in thermal testing [1]. Due to the thin nature of this insulation material, goods made of thinsulate can be made incredibly light-weight and compact. It is also hypoallergenic. Yet another advantage of this material is its ability to retain its original shape and condition during the laundering process [2].



1 – Human body; 2 – material; 3 – warmth effect; 4 – thinsulate; 5 – water evaporation.

Fig. 1 – Warmth Effect

The process of heat conservation by typical insulation is due to air being trapped by thin fibers. More effective materials can trap larger volumes of air,

thereby increasing heat retention efficiency. A higher count of fibers present in a particular area of material results in an increased volume of trapped air. The fibers in the thinsulate are only 2-5 microns in diameter [3]. This extremely thin size allows for a higher than average number of fibers to be present in a given area of material. Because of this, thinsulate provides significantly more air, and therefore heat, retention per volume of material compared to the average insulated clothing.

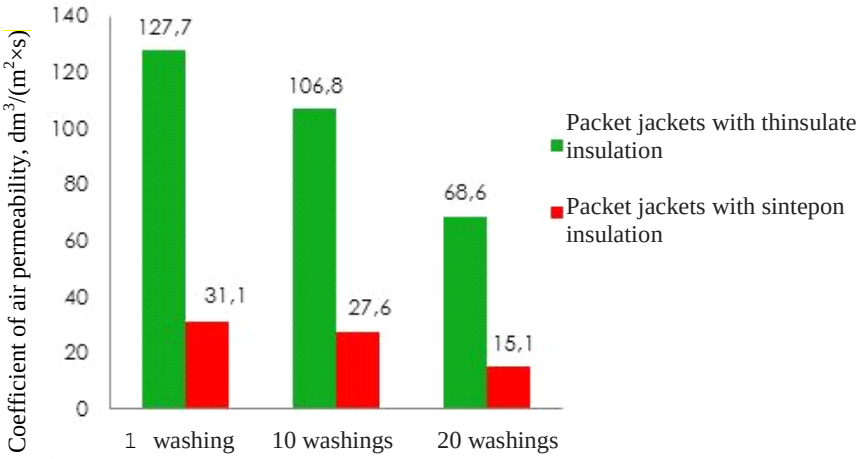


Fig. 2 – Effect of washing for coefficient of air permeability

The chart (Fig. 2) demonstrates that the thinsulate has a significant advantage over a sintepon even after twenty washings. Thinsulate maintains a low coefficient of air permeability after extensive laundering, allowing it to conserve more heat over a longer period of time.

Some buyers noticed that thinsulate is not effective against very severe frosts. Several sources and forums were analyzed to develop recommendations for the densities of insulation in certain types of clothing.

Recommendations on the use of insulation density:

• 40-70 g/m^2: high physical activity in conditions of cold weather; clothes for work, casual wear, children's clothing for active winter sports;

• 100 g/m^2: average physical activity in conditions of cold weather; clothes for work, trips, walks;

• 150 g/m^2: low physical activity in conditions of very cold weather; clothes for hunting, fishing, traveling on a motorcycle;

• 200 g/m^2: low physical activity in conditions of extreme cold weather; also includes clothes for hunting, fishing, traveling on a motorcycle.

References:

1. Zhao Lihuan. (2009). Factors affecting recovery of PTT shape memory fabric to its initial shape. International Journal of Clothing Science and Technology. 21, 64-73.

2. Stoyanova Diana. (2013). Influence of terry fabrics structure on dynamic sorption. International Journal of Clothing Science and Technology. 25, 243-256.

3. Benltoufa S. (2012). Determination of yarn and fiber diameters after swelling using a capillary rise method. Journal of The Textile Institute. 5, 517-522.