

Overview on Types and Materials of Sleeping Bag

Trisha A., Jayapriya M., Preethi N.
B. Tech

Fashion technology Scholars,
Kumaraguru College of Technology, Coimbatore

Dr. S. Kavitha,
Assistant Professor,

Department of Fashion Technology,
Kumaraguru College of Technology, Coimbatore

Abstract:- A sleeping bag is a blanket-like bag that allows individuals sleep comfortably and safely. It acts as a close alternative to a bed in situations where a bed is not available. Sleeping bags offer several advantages. They provide warmth, protection from cold winds, a cushioning effect, and protection from rain. Individuals choose sleeping bags according to size, season rating, comfort rating, and insulation. The market for sleeping bags is rapidly expanding due to an increase in outdoor activities such as hiking, hill walking, climbing, and camping. The sleeping bag market is influenced by the rise in the popularity of outdoor recreational activities, promotion of camping sites on social media & online platforms and increase in awareness about rock climbing. Sleeping bags have evolved into a must-have item when packing for a camping trip. The rise of e-commerce makes sleeping bags and their variants more accessible to consumers, which contributes to the market's increased demand for sleeping bags. This paper reviews about different types of sleeping bag, material used for manufacturing and latest trends in the market.

I. INTRODUCTION

A sleeping bag is a necessary textile item designed to protect persons in cold or hot outdoor settings. They are frequently utilised in field training, rescue, and relief operations and are also becoming into standard equipment for travel and leisure for regular people. A sleeping bag is an insulated covering for a person, essentially a lightweight quilt that can be closed with a zipper or similar means to form a tube, which functions as lightweight, portable bedding in situations where a person is sleeping outdoors (e.g. when camping, hiking, hill walking or climbing). Its primary purpose is to provide warmth and thermal insulation through its synthetic or down insulation. It also typically has a water-resistant or water-repellent cover that protects, to some extent, against wind chill and light precipitation, but a tent is usually used in addition to a sleeping bag, as it performs those functions better. The bottom surface also provides some cushioning, but a sleeping pad or camp cot is usually used in addition for that purpose. The bottom surface of a sleeping bag may be moderately water repellent, but a plastic tarp or groundsheet is often used to protect against moist ground.

There are a range of sleeping bag models designed for different purposes. Very lightly insulated sleeping bags are designed for summer camping use or for indoor use by

children during slumber parties. Well-insulated bags are designed for cold weather use. The most well-insulated and lightweight sleeping bags, which are designed for serious hikers and adventurers, are more expensive than lightly insulated sleeping bags. One subcategory of cold-weather sleeping bag, the mummy bag, is so named because it has an insulated hood for the head. A bivouac sack is a waterproof cover for a sleeping bag that may be used in place of a tent by minimalist, experienced hikers. A bivy bag may also be carried by day hikers as a backup or emergency shelter, to be used if they cannot make it back to their starting point by nightfall due to inclement weather or getting lost.

II. TYPES OF SLEEPING BAGS

There are various types of sleeping bags:

- **Rectangular sleeping bags**

Those who need a large space while they sleep prefer the most conventional kind of sleeping bags. They are inexpensive and designed as single or a double size. Additionally, certain rectangular sleeping bags will allow to join many sleeping bags together. The disadvantage of a sleeping bag that is excessively broad or long is that it will not keep as warm as one that fits correctly and will be heavier than one need to carry.

- **Mummy sleeping bags**

These type Sleeping bags are small and completely enclose the head and body in insulation resemble a cocoon. The tapered system removes dead air spaces inside the bag that otherwise need to be kept warm, and the integrated hood reduces draughts even more. It's the typical design for high-performance, lightweight sleeping bags and is particularly effective at heat retention. The negatives of mummy sleeping bags are the restricted venting capabilities and the limited room space available within the bag .

- **Quilts**

This type may open entirely like blankets and are comparable to those seen on home mattresses. However, they are made of materials that are suitable for use outdoors, and many have foot boxes that reach the knees or lower thighs. This kind of sleeping bag guarantees flexibility, warmth, and comfort.

- **Wearable sleeping bags**

These are multipurpose and they may be used as warm outerwear in camp or during chilly noon breaks as well as a sleeping bag at night.

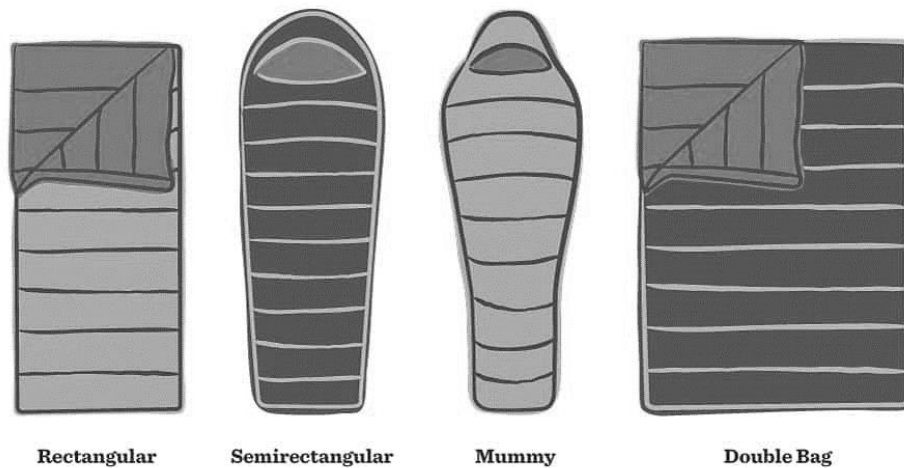


Fig. 1: Different types of shapes of sleeping bag

In addition to the shape of bag and its materials, bags can be classified based on the temperature or season rating

• **Summer-weight bags**

It is appropriate for temperatures up to roughly 30 °F. These tend to be light and thin and are only appropriate for camping in warm summer climates. A sleeping bag liner can be opted based on the hot climate outside. Most summer bags are plain sacks without need for a hood or a draught collar

• **Three-season bags**

These are the best option for the majority of temperate camping excursions since they will keep comfortable on chilly evenings in the spring or fall but won't be too hot on a warm night. These bags work best for journeys in the

spring and fall as well as in the high mountains during the summer when temperatures can drop below freezing at night. They are ideal for temperatures of around 20°F and above. With features like cinch-able hoods, draught collars, and zipper draught tubes, good three-season backpacks can withstand lower temperatures

• **Winter bags**

These are must when camping in frigid, sub-zero temperatures. They tend to be heavier, thicker, and more costly than other bags. These puffy cocoons have more insulation and all the characteristics of a three-season bag (cinch-able hoods, draught collars, and zipper draught tubes), making them suitable for temperatures of around 20°F and below.

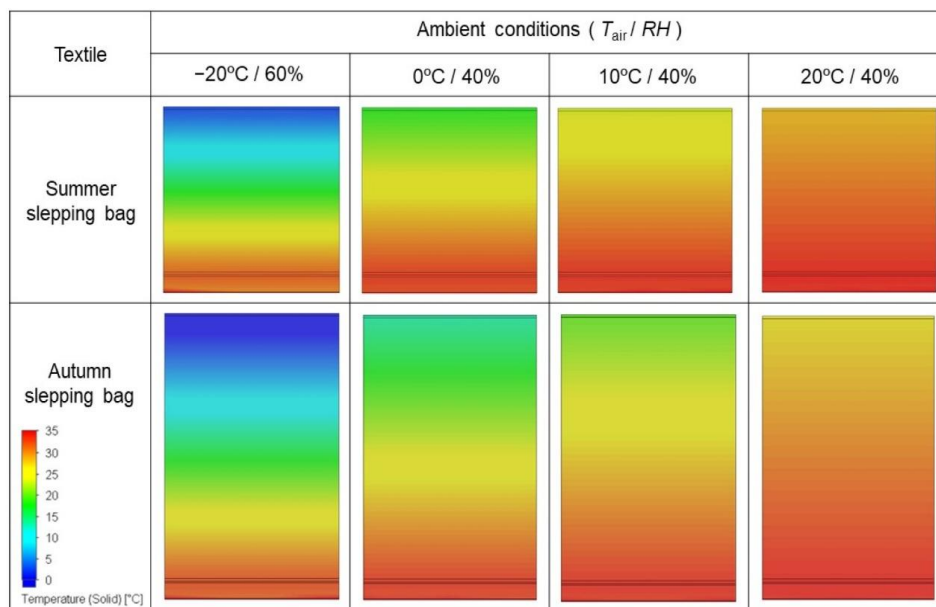


Fig. 2: Sleeping bag and ambient conditions

III. TEMPERATURE RATINGS

All sleeping bags have temperature ratings that show the bare minimum that they are made to withstand. However, temperature ratings should be regarded with caution as there is currently no standardised, universal method for doing so. Europe has widely embraced a brand-

new, uniform grading system called EN 13537. ISO 23537-1:2016 standard replaced the EN 13537 standard which describes the method for the assessment of the performance in steady-state conditions of a sleeping bag with regard to the protection against cold.

EN13537 Temperature Rating



Fig. 3: Temperature rating

The system rates bags on a scale of 1 to 5:

- Upper limit - the greatest air temperature at which the average man can sleep peacefully.
- Comfort -The lowest air temperature at which a woman can sleep soundly is considered to be comfortable.
- Lower limit - the lowest air temperature at which a man can sleep soundly.

Typically, traditional sleeping bags consist of the filling, an inner layer, and an outer layer. The maximum temperature, the comfort temperature, the limit temperature, and the extreme temperature must all be marked on sleeping bags. The two most crucial temperatures for consumers out of these four named temperatures are comfort temperature and limit temperature. The term "comfort temperature" refers to the lowest temperature at which a typical woman might sleep for eight hours in a relaxed position (i.e., lying on her back) without feeling cold.

The environmental variables include the air temperature, mean radiant temperature, air velocity, and relative humidity. Over the course of the night, these conditions are constantly shifting. For instance, the temperature might be 4 °C (40 °F) when a person enters the bag at night and drop to -7 °C (20 °F) by dawn. Interaction with environmental moisture (e.g., rain, snow) and wind may also minimise the insulation of the bag. In warm weather, the sleeping bag system really needs less insulation.

There are different factors regard to when assessing sleeping bags.

- Category of insulation.
- sleeping bag size
- Sleeping bag weight.
- Weather conditions like wind or humidity.
- The temperature at which the person choose to sleep during night.
- Price factors

IV. INSULATION TYPE

Although there are various varieties, selection of a sleeping bag should be also based on the materials used for filling. The type of insulation or fill chosen is the most important consideration, followed by how warm a bag and how small it should be. The perfect bag would be lightweight but very warm, low in packed bulk, sturdy, non-absorbent, quick-drying, warm when wet, comfy, and handy sleeping bag.. The primary decision is between synthetic fibres and reaches down.

Insulation Used in Sleeping System

AT thru-hikers survey responses in 2021

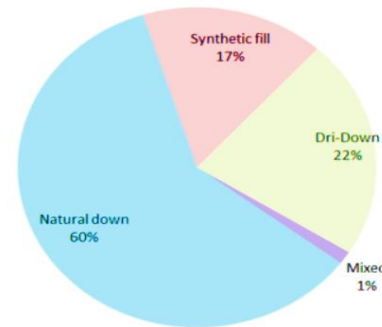


Fig. 4: Insulation used in sleeping system

A. Down

The lightest and most effective insulation available is made of down. In addition, it holds its loft (and hence insulating capacity) longer than synthetics and is the most compressible of all materials, which is a huge benefit for backpackers carrying heavy loads. The cost of down varies from synthetic, but it also relies on the fill-power, which is a measure of the down's quality. The fill-power ratings are between 600 and 900. The value represents how many cubic inches one ounce of down uses up in a beaker. The higher the number, the warmer it will be because the loftiest down is the warmest down.



Fig. 5: Down

B. Synthetic

There are many various types of synthetic insulation, but it is typically a fluffy polyester material that does not absorb water, making it a good choice for any camper who could be confronted with damp weather. Although synthetic bags are often bigger and heavier, they are substantially less costly.

Down

- ++ lightweight
- ++compressable to a smaller size
- ++ great for extreme cold weather
- ++ natural
- not Hypo allergenic
- performance deteriorates in wet weather
- expensive

Synthetic

- heavier
- bulkier
- ++ performs well in wet weather
- ++ man made
- ++ great for Allergy prone users
- ++ keeps insulating even when wet
- ++ cheaper

V. CONSTRUCTION

There are many methods of sewing all soft little filaments or down feathers together to achieve the greatest warmth out of a sleeping bag. Down bags are usually constructed with the baffle box or sewn through method, whereas synthetic bags comes in shingle or the layered construction. Down bags have inner walled compartments sewn in that are filled with insulation; others use baffle tubes or shingles of fill arranged and sewn together to keep the fill from bunching up or shifting around within the shell. Some bags use a layer of insulated quilting to provide warmth. Besides the amount and type of fill being used, the method used to secure the insulation in place plays an important role in insulation and warmth

Each method has its pros and cons like the sewn through method usually offers more chances of a cold spot to seep through, whereas an overlapping layer traps air and prevents the warmth from escaping. But bags with the sewn through construction are usually lighter too.

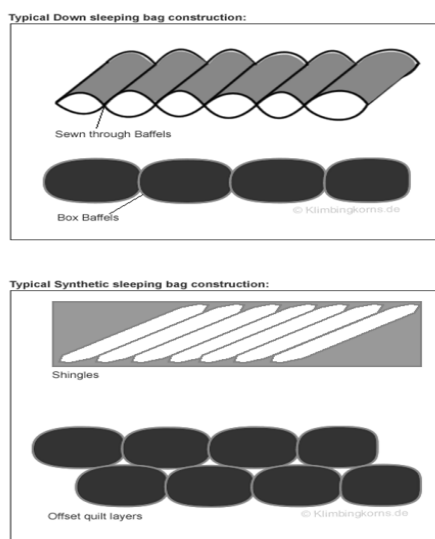


Fig. 6: Typical sleeping bag construction

Technique	Description
Sewn-through/stitch-through	Used on bags with low volumes of fill (no baffling). Stitching that pulls the shell and lining close together can create cold spots along that seam. Often used in down bags
Box Baffles	Basically a four-sided chamber, with straight or slanted sides or trapezoidal in shape. Some box baffles are stacked in two layers, offset at the seams like laying bricks in a wall.
Shingle Baffles	Attached to the shell and the lining, these sheets or sections of insulation overlap like the shingles on a roof. A modified shingle baffle, called “Wave construction” uses a shingle longer than the space length forcing the sheet of shingle to compress into a wave formation
Continuous Baffles	Wraps the insulation around the entire bag allowing for shifting a portion of the insulation from the top to the bottom based on seasonal temperatures
Side Block Baffles	Another seasonal adjustment that enables user to shift insulation from torso to lower body
V-tube Baffles	V” or triangular-shaped baffles are used to keep down from shifting. Slightly heavier due to number of baffle walls throughout bag.
Offset Quilting	Features offset stitching of layers of insulation panels. In inexpensive, warm weather bags, the shell, the quilted layer and the lining are all stitched together and as such are prone to cold spotting along those seams.
Other construction methods	Differential cuts create a sleeping bag where the outer shell is slightly larger than the inner liner. Differential fill means more insulation is on top rather than on the bottom of the bag. Some manufactures also use welding to fuse the baffling to the shell and liner thereby eliminating all puncture breaches to those surfaces

Table 1: Some bags use a combination of these construction techniques

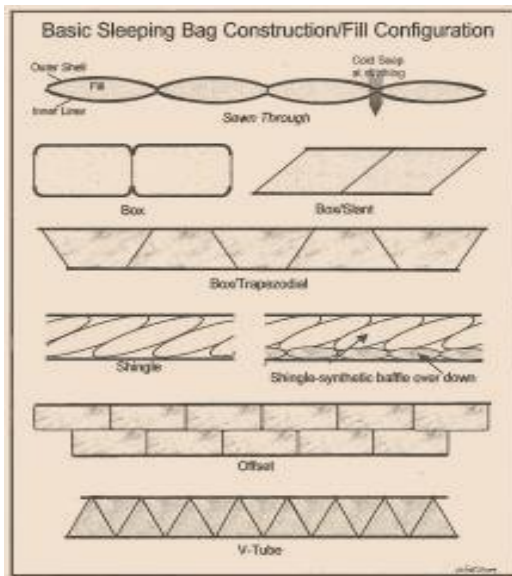


Fig. 7: Fill configuration

VI. PARTS OF A SLEEPING BAG

- **Shell** - The shell fabric makes up the exterior of the sleeping bag. The shell fabric is usually more durable than the lining fabric, and sometimes features water-resistant or waterproof breathable technology.
- **Lining** - The interior fabric of the sleeping bag is the lining. It is usually soft and comfortable, and sometimes features moisture-wicking technology.
- **Anatomical Hood** - The hood of a sleeping bag is insulated and works to prevent heat loss from your body and the sleeping bag. An "anatomical" hood is a hood that is designed to fit the shape of the neck and head for increased comfort and thermal efficiency.

Sleeping Bag Components

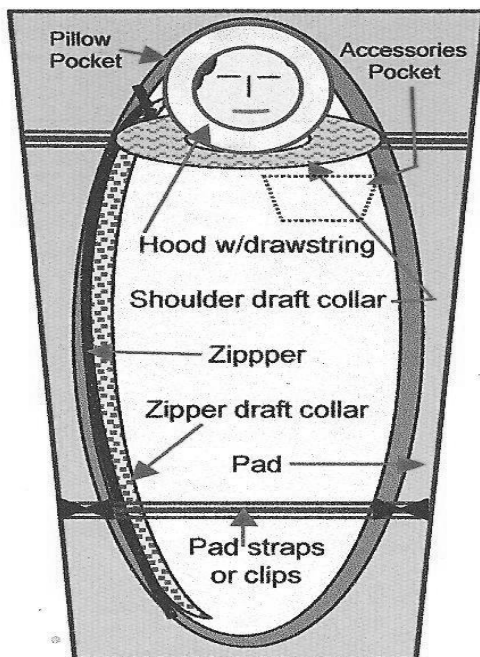


Fig. 8: Sleeping bag components

- **Pillow pocket** - A pocket inside the hood where clothes can be stuffed or a camp pillow for head cushioning and support.
- **Stash pockets** - Some sleeping bags feature stash pockets in the hood, chest or other areas. A hood pocket.
- **Draft collar** - The draft collar, sometimes referred to as a "head gasket," is an insulated collar around the hood. The draft collar stops heat from escaping the sleeping bag. It can usually be tightened or loosened by a drawcord.
- **Drawcord collar** - A drawcord collar tightens and loosens the hood or draft collar of the sleeping bag to prevent heat loss.
- **Baffle** - the seams running across the shell of sleeping bag are baffles. They're needed to keep the insulation from shifting or clumping. By keeping insulation in place, baffles keep cold spots and heat loss to a minimum.
- **Draft tube** - An insulated tube that runs along and behind the zipper to stop cold drafts from getting in and warm air from getting out.
- **Side Seams** - The side seams of a sleeping bag are what connect the front and back of the sleeping bag shell together. Some sleeping bags feature ground-level side seams, which are more thermally efficient because they allow the front layer of the sleeping bag to wrap all the way around the body.
- **Two-way zippers** - Two-way zippers allow to close or open different sections of the sleeping bag to regulate temperature.
- **Zipper lengths** - Full-length zippers make it easier to get in and out of the bag and regulate temperature, half-length zippers save a bit of weight, and no-zipper sleeping bags are ideal for ultra-lighters.
- **Footbox** - The footbox of a sleeping bag is the section where a person's feet will be located when they are sleeping. A "trapezoidal" or flared footbox allows more space for feet to rest comfortably. Some mountaineering sleeping bags have more spacious footboxes to allow room for hot water bottles and boot liners.
- **Pad loops** - Some sleeping bags have pad loops on the sides that are meant to connect to sleeping bag and keep it in place while sleeping.
- **Hanging loops** - If there are loops on the bottom of sleeping bag, they are intended for hanging the bag to dry. Hanging the bag to dry, rather than drying it flat, will maintain insulation loft.

New Features in a sleep bag

➤ **The compression bag or stuff sack**

Compression sacks offer four way compression with adjustable straps, which can be pulled tight to make the size of sleeping bag as compact as possible. Stuff sacks can also be a handy way to store sleeping bag but do not have the ability to be crushed down with compression straps as compression sacks are.



Fig. 9: Stuff sack

➤ Insulation Enhancing Features

Sleeping bag hoods are a useful feature as they help to insulate the head, which is one of the areas of the body which loses heat the fastest. Another feature suitable for on the higher season options is an adjustable shoulder baffle. It basically forms a collar inside the sleeping bag which prevents warm air from escaping and keeps warm during the night in cold temperatures.

➤ Zip Related Features

A two way zip to make it easier to open from the inside as well as the outside.



Fig. 10: Two way Zippers

➤ Internal Pocket

These pockets have become more and more popular, especially when it comes to travel sleeping bags. Internal pockets are usually a sleeve-style pocket with a Velcro fastening and are found inside the sleeping bag, these are typically used for storing valuable items to keep them safe and close to hand while the person is sleeping.

➤ Features offered by different manufacturers

- ✓ Classic Spoon™ shape adds room at elbows and knees for versatile comfort. Forte's classic Spoon™ shape provides a generous cut at the elbows and knees so side sleepers can shift positions comfortably throughout the night.
- ✓ Updated with Primaloft® RISE insulation, featuring 80% post-consumer recycled content, and engineered to deliver maximum warmth retention and water resistance with less weight than conventional synthetic insulation.
- ✓ A fabric set of 30D Nylon Ripstop and 20D Nylon Taffeta offers an ultra-plush sleep experience.
- ✓ Thermo Gills™ allow to vent body heat without letting cold drafts in.
- ✓ Blanket Fold™ external draft collar and a full-length draft tube provide tucked-in comfort and temperature regulation.

- ✓ Full-length double-slider #5 YKK zipper with zipper flow makes getting in and out of the bag a breeze.
- ✓ Integrated pillow pocket allows a jacket, extra clothes, or Fillo™ to be stuffed into the sleeve opening for secure, elevated support through the night.
- ✓ Opposite-sided zippers on Forte™ Men's and Women's models increase versatility by allowing them to be zipped together into a double sleeping bag.
- ✓ This wearable sleeping bag is suitable for all the camping activities with Comfort rated at 45°F, with a 37° limit, it features an insulated hood, leg vents, removable booties, among other nifty design details and comes in a variety of colours and sizes (including kids).



Fig. 11: Wearable sleep bag

- An assistive sleeping bag for children with autism spectrum disorder
- Trajectory's sleep bag has Carry cover provided with the products
- Harrison's products are made of vegan material and they are reversible.
- YFXOHAR's sleeping bags are equipped with an extra zipper and windproof buckle
- LWVAX's It is multi-use as it can be used as a comforter as well as a sleeping blanket apart from being used as a sleeping bag.

VII. CONCLUSION

A sleeping bag is a great alternative to a bed in situations which allows to sleep comfortably and safely. A sleeping bag has lot of types from which any one can choose starting from the shape of the bag to its material. These bags can also be classified based on the temperature or the season's ratings. The perfect Bag should be lightweight, but very warm, low impact bulk, sturdy, Non-absorbent, quick-drying, warm, comfy and handy. When a person chooses a sleep bag they choose it by assessing the different factors like the category of insulation, sleep bag size, sleep bag weight, weather conditions, the temperature at which the person chooses to sleep, price factors etc. The construction of the sleep bag varies and it is a combination of many techniques depending on the insulation and warmth required. It is noticed that constant growth in sleep bag market is achieved as it is regularly used by people for travel, leisure and other purposes, New features have been introduced by many companies constantly which makes way for the growth of sleep bags in the modern world.

REFERENCES

- [1.] Skrzetuska E, Agier M, Krucińska I. Study of Influence of Atmospheric Conditions on the Thermal Properties of Sleeping Bags. *Materials*. 2022 Mar 8;15(6):1992.
- [2.] Gao, J.; Yu, W.; Pan, N. Structures and Properties of the Goose Down as a Material for Thermal Insulation. *Text. Res. J.* 2007, 77, 617–626
- [3.] PN-EN ISO 23537-1:2017-02; Requirements for Sleeping Bags—Part 1: Thermal and Dimensional Requirements. ISO: Geneva, Switzerland, 2017
- [4.] Biswas TT, Infirri RS, Hagman S, Berglin L. An assistive sleeping bag for children with autism spectrum disorder. *Fashion and Textiles*. 2018 Dec;5(1):1-2.
- [5.] <http://www.gapyeartravelstore.com/blog/what-are-the-standard-features-of-a-sleeping-bag/>
- [6.] <https://www.campingintheforest.co.uk/blog/camping-information/what-fabrics-are-used-for-sleeping-bag-shells-and-linings>
- [7.] Zhang C, Ren C, Li Y, Song W, Xu P, Wang F. Designing a smart electrically heated sleeping bag to improve wearers' feet thermal comfort while sleeping in a cold ambient environment. *Textile Research Journal*. 2017 Jun;87(10):1251-60.
- [8.] Brooker E, Joppe M. Trends in camping and outdoor hospitality-an international review. *J Outdoor Recreat Tour* 2013; 12: 1–6.
- [9.] McCullough EA, Huang J and Jones BW. Evaluation of EN 13537 and other models for predicting temperature ratings of sleeping bags. In: *The 11th international conference on environmental ergonomics (ICEE)*, Ystad, Sweden, 22–26 May 2005.
- [10.] Holand B. Comfort temperatures for sleeping bags. In: *The Third International Meeting on Thermal Manikin Testing 1999* (pp. 25-8)
- [11.] Cummings M, Slater K. Consumer benefits of policies and regulations in the tent and sleeping bag industry. *Journal of Consumer Studies & Home Economics*. 1996 Jun;20(2):107-15.
- [12.] Livingstone SD, Nolan RW, Cottle WH, Cattroll SW. The composition of air in sleeping bags. *International journal of biometeorology*. 1988 Mar;32(1):29-32.