INNOVATIVE INSULATION AND HEAT PRODUCING FABRICS FOR SHELTER PURPOSES

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IFRC SRU
Luxembourg
2015
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• NEW FABRICS
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• CONCLUSION
SHELTERS

• FABRICS

• FIBRES
FABRICS FOR SHELTERING PURPOSES

• WOVEN FABRICS

• KNITTED FABRICS
  • WARP AND WEFT KNITTED

• NON-WOVEN FABRICS
  WEB BASE, FELT AND OTHERS
WHAT ARE THE THINGS TO CONSIDER

• INSULATING PROPERTIES

• PRODUCT VARIETY

• FAST PRODUCTION

• COST
FABRIC TO USE

• NON-WOVEN
WHAT ARE NON-WOVEN FABRICS?

Nonwovens are unique, high-tech, engineered fabrics made from fibres and which are used across a wide range of applications and products. Nonwovens are innovative, versatile and indispensable. Modern life would be quite literally impossible without them.

A nonwoven is a sheet of fibres, continuous filaments, or chopped yarns of any nature or origin, that have been formed into a web by different means, and bonded together by many different methods, with the exception of weaving or knitting.
RAW MATERIALS FOR NON-WOVENS

• ANY FIBRES (NATURAL AND MAN-MADE) CAN BE USED FOR THE PRODUCTION OF NON WOVENS

• FIBRES CAN BE USED IN STAPLE (SHORT AND LONG) OR FILAMENT FORM
AREAS OF USE

• Geotextile
• Automotive
• Clothing and Shoe wear
• Wipes and mops
• Artificial leather
• Hygiene (diapers)
• Medical
• Filter
• Industrial
NON-WOVEN PRODUCTION

WEB FORMATION

WEB BONDING
NON-WOVEN PRODUCTION

WEB FORMATION

FLAMENT PROCESS

- SPUNBONDED
- MELTBLOWN

WET LAID

DRY LAID

- CARDING
- AIR LAID
**NON-WOVEN PRODUCTION**

**WEB BONDING**

- **CHEMICAL BONDING**
  - PULVERIZATION
  - PADDING
  - FOAMING
  - PRINTING
  - COATING

- **HEAT BONDING**
  - CALENDERING
  - ULTRASONIC BONDING
  - OVEN

- **MECHANIC BONDING**
  - NEEDLE PUNCH
  - WATER JET
  - STITCH BONDING
DRY WEB FORMATION AND NEEDLE PUNCH NON-WOVEN PRODUCTION

Needled Nonwoven Equipment Production Line
NON-WOVEN PRODUCTION
ADVANTAGES OF NON WOVEN FABRICS

• Very short time to produce

• Production varieties

• Superior properties (heat and sound insulation, etc.)
FIBRES

• NATURAL FIBRES
  – VEGETABLE FIBRES
  – ANIMAL HAIR FIBRES
  – INORGANIC FIBRES

• MAN MADE FIBRES
  – REGENERATED FIBRES
  – SYNTHETIC FIBRES
  – INORGANIC FIBRES
IMPORTANT FIBRE PROPERTIES

• PRODUCT PRODUCTION VARIETIES
• HEAT AND SOUND INSULATION
• HEAT GENERATION
• FIBRE LENGTH
• FIBRE THICKNESS
• FIBRE DENSITY
• AVAILIBILITY
• ECO FRIENDLY (RECYCLED)
• COST
FIBRE TO USE

• SYNTHETIC FIBRES
  • (IN TECHNICAL USE)
FIBRES TO USE

- Synthetic fibers
- Recycled fibers
- Hollow fibers
- Micro, Nano fibers
- FR fibers (Inherently)
- Insulating fibers
- Heat generating fibres
TENTS

Tents from past to present

• First settlements after cave
• First dwellings before permanent dwellings
• Military temporary settlements
• Sports and leisure use
• Natural disaster and refugee camps
TENTS

The use of tents in ages

• Most civilizations (Ancient Egypt, Roman Empire, Mongolians, Ottoman Empire, American Indians, etc.) used tents in various activities.

• Living quarters,

• Military purposes

• Sports and other activities

• For temporary settlements
TENT FABRICS USED IN HISTORY

• Felt fabrics from natural hair fibers
• Non woven fabrics
• Woven fabrics
• Made with natural fibers
Non-woven fabrics based on traditional felt technology. Felt is a non-woven fabric made using natural fibres, water, soap and agitation to form a dense fabric of permanently interlocking fibres.
TENTS TODAY

- Tents are mostly used in natural disasters and refugee camps
- Military, sport and leisure activities
- Nearly all tents are made from woven fabrics
- Very little non woven fabrics are used
- Man made fibers are also used besides natural fibers
PROJECT ABOUT IMPROVEMENT OF TENT FABRIC

DEVELOPMENT OF ECO-FRIENDLY NONWOVEN BASED NATURAL DISASTER TENT FABRIC THAT HAVE FLAME RETARDANCY, WATER REPELLENCY, HEAT AND SOUND INSULATION, ANTI BACTERIAL, AND BREATHABILITY PROPERTIES
RELEVANT INSTITUTIONS AND ORGANIZATIONS

PROJECT COORDINATOR
•  HASSAN GROUP (Ch.E. Umut Burak DALBUDAK)

ACADEMIC CONSULTANCY
•  MARMARA UNIVERSITY (Prof. Dr. Mehmet AKALIN)

FINANCIAL SUPPORT
•  TUBITAK (Scientific and Technological Research Council of Turkey)

BENEFICIARY ORGANIZATIONS WITH TECHNICAL AND APPLICATION SUPPORT
•  TURKISH RED CRESCENT
•  IFRC SRU
AIMS OF THE PROJECT

- Need to protect from fire
- Fire is the most common cause of fatalities in camps and tents
- Use of inherently flame retarded fibres in non-woven production
Need to protect from cold weather conditions

- Advantages of using non woven for cold weather conditions
- Varieties of non woven production for insulation
- Present usage of non woven internally in Turkish Red Crescent Tents.
Need to protect from hot weather conditions

• Natural disaster and refugee camp tents are also used in hot weather conditions.

• Advantages of using non-wovens for hot climate conditions
Need for sound insulation

• High number of tents and their close proximity.
• Advantages of using non woven for sound insulation
Need of protecting tents from harsh weather conditions (i.e. heavy rain)

- Adverse effects of rain in tents
- Problem of condensation
- Need for breathability
Importance of breathability of the tent fabric

- Problem of condensation caused by cooking and breathing in a tent.
- Need to keep the tent condensation free.
- Breathability of the fabric used for tent is important
Need to keep the tent anti microbial and reduce the effects caused by insects.

- Due to outside conditions and the presence of high humidity within the tent specially made with natural fibres microorganisms grow very quickly.
- Insects are drawn into tents due to cooking activities which spreads the disease.
OVERALL AIM

• IMPROVE ALL ABOVE PROPERTIES

• REDUCE THE WEIGHT

• REDUCE THE COST

• INCREASE THE STORAGE, SHELF LIFE OF THE TENTS

• THE MOST IMPORTANTLY REDUCE THE TIME OF PRODUCTION AS A RESULT REDUCE THE TENT STOCKS
What materials are used in natural disaster tents today?

- Outer roof fabric (woven with coated PVC)
- Outer side walls (woven fabric)
- Inner tent fabric (woven for Red Cross, non woven for Turkish Red Crescent)
- As a fibre mostly cotton, polyester and poly/cotton are used
What materials are used in natural disaster tents today?
TENT FABRIC TESTS

MECHANIC TESTS

• Area Density g/m$^2$
• Thickness mm
• Tensile Strength and Elongation N, %
• Tearing Strength N
• Tensile Elongation Under 100N Load (Creep Deformation) %
TENT FABRIC TESTS

OTHER PROPERTIES TESTED

- Anti bacterial effect \( \% \)
- pH
- Martindale Abrasion
- Sound Absorption \( \alpha \)
- Air Permeability mm/s
- Thermal Coefficient of Resistance m\(^2\)K/W
- Water Vapour Resistance m\(^2\)Pa/W
- Flame Retardancy
- Ultrasonic Weldability
# TENT FABRIC TEST RESULTS

## Comparison Table

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Test Method</th>
<th>Unit</th>
<th>Non Woven Tent Fabric</th>
<th>Outer Woven Side Walls</th>
<th>Inner Woven Tent Fabric</th>
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<tbody>
<tr>
<td>Fiber Type</td>
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<td>100% PES</td>
<td>100% Cotton</td>
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<td>Anti Bacterial Effect</td>
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<td>Anti Bacterial Effect</td>
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<td>-</td>
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<td>NO</td>
<td>NO</td>
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</table>
TESTS ON TENTS

• SAMPLE TESTS (1m³)
  • FIELD TESTS
RESULTS

• % 30 LESS ENERGY IS REQUIRED TO KEEP THE NON-WOVEN FABRIC BOX (1m3) AT CONSTANT TEMPERATURE THAN THE STANDARD WOVEN FABRIC BOX (1m3)
RESULTS

Compared with exterior minimum recorded temperature, the winter room provides a reduction of 5.9°C.
The Kizilay tent without winter room provides a reduction of 6.6°C. (1.1°C colder than the tent with winter room)

Preliminary conclusions
The winter room has an insulation capacity more effective than the Kizilay tent without winter room on the mile recorded temp.

Table 08: The minimum and maximum temperature measured inside the tent Kizilay tent with winter room and the Family tent with winter kit during the testing period, in comparison to the outside max and min temperatures.

Compared with exterior maximum recorded temperature, the winter room provides a positive reduction of around 4°C.
The Kizilay tent without winter room does not provide a significant reduction on the maximum recorded temperatures, furthermore the greenhouse effect in one of the tents provides an increase of the max temperatures in 4.7°C.

Preliminary conclusions
The winter room has an insulation capacity more effective than the Kizilay tent without winter room on the max recorded temperatures.
RESULTS

• BOTH FIELD RESULTS HAVE SHOWN THE IMPORTANCE OF TENT DESIGN
RESULTS
CONCLUSIONS

• NON-WOVEN PRODUCTION IS THE FAR MOST SUPERIOR METHOD OF PRODUCTION OF FABRICS FOR INDUSTRIAL USE IN TERMS OF;
  » PRODUCTION SPEED 50000 TENT 2500000M2 FABRIC
  » NO NEED FOR LARGE STOCKS
  » LESS STOCK KEEPING COSTS
  » STOCKING PROBLEMS DUE TO HEAT AND HUMIDITY
  » COST ((AT LEAST %30))
  » BETTER FABRIC PROPERTIES
  » WIDER RANGE OF PRODUCTION
  » VARIETY OF FIBRE USE
  » COMBINATION WITH DIFFERENT PRODUCTION TECHNIQUES
CONCLUSIONS

• IN THIS PROJECT TENT FABRICS TESTED; NON WOVEN FABRICS HAVE SHOWN PROPERTIES BETTER THAN WOVEN FABRICS INTERMS OF;
  – HEAT AND COLD INSULATION
  – SOUND INSULATION
  – WATER REPELLENCY
  – FLAME RETARDANCY
AND BESIDES THAT FABRICS WERE
  – ANTIMICROBIC
  – BREATHABLE PERMEABLE
  – UV ABSORBER (FOR SUMMER USE)
  – ULTRASONICLY WELDABLE
  – ENVIRONMENTAL FRIENDLY, SUSTAINABLE (RECYCLED RAW MATERIAL)
CONCLUSIONS

• FIELD TESTS HAVE SHOWN ALSO BETTER PROPERTIES;

  – USING LESS ENERGY TO KEEP THE TENT AT CONSTANT TEMPERATURE (KEEPING WARMER)
  – GREEN HOUSE EFFECT (COOLER) IN ONE TEST
CONCLUSIONS

• AS A RESULT OF THIS PROJECT WE HAVE PRODUCED FOUR IMPROVED NON WOVEN FABRIC FOR TENTS;

  » IMPROVED NON-WOVEN INNER TENT FABRIC (WINTERSATION AND SUMMER KIT) (NEW)
  » NON-WOVEN OUTER TENT FABRIC (NEW)
  » METALISED OR PVC COATED NON-WOVEN ROOFING FABRIC (NEW)
  » NON-WOVEN FLOOR FABRIC (NEW)
CONCLUSIONS

• FOR ALL NEW FABRICS (INNER AND OUTER) PRODUCED; SPECIFICATIONS HAVE BEEN DETERMINED

• THOSE FABRICS HAVE BECOME ONE OF THE NEW FABRICS FOR TENTS USED BY TURKISH RED CRESCENT AND FABRIC SPECIFICATIONS OF WHICH IS ANNOUNCED
### TECHNICAL DATA SHEET

**PRODUCT CODE:** N118  
**PRODUCT NAME:** NON WOVEN TENT FABRIC

<table>
<thead>
<tr>
<th>RAW MATERIAL</th>
<th>FIBER TYPE</th>
<th>100% PES (RECYCLED)</th>
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</thead>
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<th>UNIT</th>
<th>CRITERIA OF ACCEPTANCE</th>
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<tr>
<td>ULTRASONIC WELDABILITY</td>
<td>-</td>
<td>YES</td>
<td></td>
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</table>
NEW RESEARCH ON HEAT GENERATING AND COOLING FABRICS FOR TENTS

• ONLY HEAT GENERATING FABRIC WILL BE MENTIONED (NOT COOLING FABRIC (PCM) IN THIS PRESENTATION TODAY)

• OUR AIM IN THIS RESEARCH IS TO HEAT THE FABRICS (INNER TENT ITSELF) PRODUCED IN PREVIOUS STUDY WITH VERY LOW ENERGY CONSUMPTION AND VOLTAGE

• AS A RESULT REDUCE THE RISK OF FIRES AND ENVIRONMENTAL POLUTION DUE TO COAL BURNING STOVES AND ELECTRIC BLANKETS
NEW HEAT GENERATING NON-WOVEN FABRICS

INITIAL WORK CARRIED OUT

• BASE FABRIC WAS CHOOSEN AS NON-WOVEN FABRIC FROM THE PREVIOUS PROJECT

• CHEMICAL COMPOSITION OF VARIES MATERIALS FOR HEAT GENERATION ARE PRODUCED

• NEW MATERIALS ARE TESTED FOR HEAT GENERATION

• ONE OF THE MATERIAL TESTED HAVE SHOWN THE MOST HEAT GENERATION AND EAS OF APPLICATION

• VARIES METHODS OF APPLICATION IS TESTED ON THE MAIN PRODUCTION LINE FOLLOWING THE FABRIC PRODUCTION

• MOST APPROPRIATE APPLICATION TECHNIQUE IS ALSO CHOOSEN FOR THE PRODUCTION
REASONS TO CHOOSE BASE FABRIC AS NON-WOVEN

• AS IT WAS EXPLAINED ON THE PREVIOUS STUDY

• THIS NON-WOVEN FABRIC HAS BETTER INSULATING PROPERTIES ITSELF

• APPLICATION OF HEAT GENERATION MATERIAL IS EASIER AND SUITABLE FOR NON-WOVEN PRODUCTION

• DIFFERENT FIBRES AND FIBRE BLENDS CAN BE USED
COMPOSITION OF HEAT GENERATING MATERIAL

• THIS IS A SPECIAL BLEND OF SYNTHETIC POLYMER WITH CONDUCTIVE MATERIALS
HEAT GENERATION CAPACITY OF NEW FABRIC

- 12 V  2,1 A  approx. 35 °C
- 24V  2,1 A  approx. 45°C
APPLICATION OF THE MATERIAL ON THE BASE FABRIC

• SPECIAL COATING PROCESS HAS BEEN APPLIED STRAIGHT AFTER THE NEEDLE PUNCHING PROCESS ON THE SAME PRODUCTION LINE
ADVANTAGES OF THE SYSTEM

• SUSTAINABLE

• ENVIROMENTAL FRIENDLY

• SAFE

• EASY TO PRODUCE

• LOW ENERGY COSTS FOR HEATING
CONCLUSIONS

• BASE FABRIC ITSELF HAS HEAT INSULATING PROPERTIES ALREADY (FROM PREVIOUS STUDY)

• IT IS VERY PROMISING AS THIS IS THE EARLY RESULTS IN THIS WORK

• RESEARCH IS STILL PROGRESSING

• ALL OTHER PROPERTIES OF THE FABRIC IS NOT MUCH EFFECTED

• BETTER TENSILE PROPERTIES

• DIFFERENT FIBRES CAN BE USED IN BASE FABRIC AND SOME HAS SHOWN PROMISING RESULTS
Thank you for your attention...

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Brief Introduction About The Project

Our aim in this project is to improve living conditions in natural disaster tents. Improving the natural disaster tent fabrics in terms of:

- flame retardancy,
- heat and sound insulation,
- water repellency,
- breathability and
- anti bacterial properties
Reasons and aim of starting this project

- Increase in the number of natural disasters and refugee camps in the world
- Importance of improving the living conditions in the tents that one of us may have to live in.
- Loses of life in tent fires.
- Heat and sound insulation problems of tents.
- Breathability of the tents.
- Water resistance of tents due to heavy weather conditions.
- Increase of illnesses in the tents due to micro organisims and bacterials growth.
THREE IMPORTANT MAPS

- Natural Disasters and Refugee Camps Analysis
- Climate Conditions
- Population Density
INTRODUCTION
INTRODUCTION
IMPLEMENTATION METHODS

1. Literature Survey
2. Sample Trials
3. Production of Prototype
4. Pre Production
5. Feedback
INTRODUCTION

• Increase in the number of natural disasters and refugee camps in the world

• Importance of improving the living conditions in the tents that long term living and also one of us may have to live in
NEDDLE PUNCH PROCESS PARAMETERS

Penetration (mm)

Punch density (iğne/cm²)

![Diagram of Needle Punch Process Parameters](image)

![Graph of Punch Density vs Tensile Strength](graph)
What do we want to do?

- Improve the present inner tent fabrics
- Improve the living conditions in a tent
- Produce a fabric (inner, outer and for roof) to achieve this
- New idea of producing tent fabrics in a very short period of time
- Create a new specifications for the new tent fabrics
Chemicals and semi finished products that could be used in a new tent fabric

- FR chemicals
- Anti microbial chemicals
- Water resist chemicals
- Insect repellents
- Insulating paints
- Breathable films
- Metallized films
- UV additives
RESULTS

Advantages of this project

• Experiences of tent production facilities of Turkish Red Crescent and other private companies

• Experience of HASSAN in non woven fabric production

• Quicker production of non wovens in case of real emergency situations

• Better properties of nonwoven fabrics in terms of properties required for tents

• Eco friendly and sustainable production