Sustainable wool insulation textile products - an opportunity for entrepreneurial initiatives in Romania

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Abstract. The wool processing sector in Romania experienced a regression in terms of fiber quality after 1989, caused by a combination of factors: uncontrolled crossbreeding, low area and low quality pastures and lack of support for sheep breeders. As a result, the spin ability limit of the Romanian wool has decreased, as well as the possibility of using it in the textile industry, in the conditions of increasing demand for fine fabrics and knitwear, leading to the closure of many traditional textile companies and the use of imported wool. Under these circumstances, the use of the Romanian wool for related fields such as construction is much more important, as an efficient and viable alternative for recovery and an alternative for revitalization of several economic sectors. The paper presents aspects regarding the textile valorization of the thick Romanian wool varieties in order to produce materials with the role of insulation and sealing, in the field of eco-friendly constructions.

1. Introduction

Romania's rural development strategy [1] for the coming years is in line with the EU's reform and development context with the Europe 2020 strategy. Following the objectives of the Europe 2020 strategy for a smart, sustainable and inclusive economy, the strategy sets ambitious targets for Member States in the areas of education, innovation, energy/environment, employment and social inclusion and improving competitiveness in general [2].

The National Rural Development Program (NRDP) 2014-2020 [3] contributes to smart growth by supporting forms of cooperation between research institutions and farmers and other actors in the rural economy, but also by supporting training, skill acquisition and dissemination of information. The NRDP also envisages a sustained growth that focuses on lowering carbon emissions and supporting environment-friendly farming practices.

Last but not least, support for investment in infrastructure and the rural economy leads to poverty reduction and job creation in rural areas, thus contributing to inclusive growth. All these objectives will be possible to materialize only under the conditions of efficient utilization of indigenous raw materials, among which wool fibers, a valuable source both for the textile industry and for related sectors, as is the field of ecological constructions.
The wool processing sector in Romania experienced a regression in terms of fiber quality after 1989, caused by a combination of factors: uncontrolled crossbreeding, low area, low quality pastures and lack of support for sheep breeders. As a result, the spin ability limit of the Romanian wool has decreased, as well as the possibility of using it in the textile industry, in the conditions of increasing demand for fine fabrics and knitwear, leading to the closure of many traditional textile companies and the use of imported wool.

Under these circumstances, the use of the Romanian wool for related fields, such as construction, is much more important as an efficient and viable alternative for recovery and an alternative for revitalization of several economic sectors.

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2. Material and Methods

In Romania there are a variety of sheep breeds (figure 1). Romania, within the EU, but also in the Balkan area, has owned a large number of sheep heads, with a variable weight between sheep and wool sheep.

Ţurcană breed derives from the wild species Ovis Vinai Arkar, it was domesticated in prehistoric times in the Carpathian Mountains area where it was formed as a breed by natural selection.

From here it has spread through transhumance, in all the countries of Central Europe, in areas varied in relief and level of precipitation. Average wool production per capita is about 2 kg for female and about 3kg for male.

Ţurcană sheep has a woolen shell/fleece made of sharp streams that have an outer appearance of spear and corkscrew, being made of different inhomogeneous fibers. The wool is rare and “the seam line” on the upper line is wide. The streamers are long, in conical shape (characteristic of mixed wools). The internal structure of the shell is unclear, tangled.

The Ţurcană breed fleece mainly comprises long and thick fiber, on the outside, but also a layer, covered by the previous one, of shorter and thinner fiber.

There are 3(three) varieties Ţurcană breed, in Romania, namely white, black and gray varieties.
The thick and long fibers have an average length of 23-25 cm, a fineness of 56-58 µm and a pronounced medullary canal. The short and thin fibers at the base of the fleece have an average length of 9-11 cm, and a fineness of 28-32 µm.

Washing efficiency for Țurcană breed wool is about 65 -70%. In figure 2, there are details for Țurcană breed wool fleece exterior layer.

In the research expertise, non-woven infrastructure facilities from SC MINET SA Company; a representative Romanian textile company and the raw materials; washed coarse (Țurcană wool fibers) and semi-coarse (Tigaie wool fibers) Romanian wool fibers, were utilized.

3. Experimental aspects

The matrix of technological experimentation took into account the following experimental criteria [4]:

- exploiting the technological equipment of SC MINET SA, Vâlcea County (figure 3);
- two distinct technologies were used in processing: i) strengthening the fibrous material by the thermo-chemical process (for Țurcană wool), using no more than 35% of man-made adhesive fibers and ii) mechanical strengthening (for Tigaie wool);
- adaptation of technological parameters and processing stages to the characteristics of the processed fiber material;
- the coverage, according to the adjustment parameters, of the entire range of non-woven structures, possible to be obtained, based on the processing technologies used;
- design and fabrication of nonwoven fabrics with different density and thickness, covering a wide range, possible to be used by the constructors in different ways and locations of a building: floor, roof, walls;
- providing improved properties to the materials by applying functional treatments specific to insect/moth protection, flame maintenance and propagation.
The use of thick and semi-thick wools for the production of non-woven textile materials for the sound and thermal insulation of buildings is a high-potential entrepreneurial area, in the context of rising electricity, thermal and energy prices and in the context of national and European trends in green building.

4. Aspects regarding the sustainable development and natural fibers usage as raw material

There was performed also the analysis of the export capacity of Romanian eco-innovative wool products to the European countries and the directions to action for achieving this objective. Eco Textiles are present not only at clothing and garment products, but also at technical domains. It could say that this is the future, the label as Ecotech, Okeotech and Eco friendly being well known all over the world.

Civil engineering and building engineering are a significant contribution to the human society development, because these industrial fields meant planning, design, construction, manufacturing and maintenance of the infrastructures.

The connexion of the technical textiles and especially high performance technical textiles with these sectors has conducted to an increased impulse to the eco-buildings and green building development.

These textile materials are used for buildings, bridges, tunnels construction and they are generically called "Buildtech".

They offer specific physical-mechanical properties such as: reduce weight, very good mechanical resistance and resilience, as well as resistance to many factors: creep, chemical degradation and pollutants from air and rain, sunlight and acids action. These textile materials play an important role in the modernization of the construction infrastructure.

Natural textile products offer a range of environmentally responsible alternatives to other materials that are resource deficient.

They use both post-consumer and post-industrial waste streams and reuse them for the manufacture of extremely durable and environmentally friendly textile materials.

They not only generate a reduce waste, but more importantly, they save rapidly depleting natural resources.

Some of the characteristics of these textiles are: they use natural fibers, they are processed with less harmful inputs, the processing units are equipped with wastewater treatment plants, the fabrics are of good quality and long lasting use.

They can be used for: soil sealing, textile drainage systems, erosion prevention systems, textiles for protection against dangerous substances, mobile containers, sound barrier systems, filtration systems (air / water), textiles for landfills etc.

Different geo-synthetic products are used as: Geotextiles, geo-synthetic linings, geo-networks, geomembranes and various geo-specialized composites.

Other potential areas of application of geo-synthetic products: spatial planning (golf courses, ponds, etc.), rehabilitation of mines and tunnel linings, etc.

In Romania, the problem is more complex and difficult, because of the mentality and culture changing need.

The valorization of course wool fibers Turcana for the construction field is a valuable instrument for solving the problem of wool industry, on the one hand, and for the eco-building promoting, on the other hand.

5. Aspects regarding the economic efficiency

These are the arguments for which we analyzed also the economic efficiency of capitalizing Romanian wools by simulating a family entrepreneurial business, that is, a minimal investment, possible to be achieved at the level of young Romanian entrepreneurship.

It should be highlighted that not only the low price aspects must be considered, but first of all the following should be taken into account:
- the technology allows the recovery of Romanian thick and semi-thick wool fibers, a raw material which does not have suitable spinning ability characteristics for processing high fineness yarns and which is currently either burned or exported as raw material or collected in peasant farm conditions;
- the technology may be applied to companies producing non-woven textiles with technical use;
- newly created companies will contribute to the use of native resources of thick and semi-thick wools, implicitly in creating new jobs and attracting young people, especially in rural areas, where a depopulation phenomenon is currently occurring;
- the new products will contribute to the development and implementation of the concept of green houses with low construction and operating costs;
- sheep breeding is a basic occupation of most peasant farms, especially (semi)coarse wool fibers;
- the sheep wool is sheared once a year and the raw (greasy) wool obtained is collected and sent to a collecting center, to be forwarded to the wool laundry.

As a consequence, a business plan simulation, based on the technical data obtained in the technological experiments, was elaborated by SC MINET SA, Râmnicu Vâlcea and INCDETP. The potential users of the research results are:
- sheep breeders,
- breeders' associations,
- economic units with activity in the field of wool manufacturing,
- decision-makers in the field of industry and agriculture,
- young entrepreneurs.

6. Conclusion

The analysis of the construction materials market shows an increased interest in the use of wool as a thermal insulation material, leading to an economically significant impact, as the construction sector is a major energy consumer within the European Union, accounting for 40% of the total energy consumption and 36% of greenhouse gas emissions [5].

In the conditions of increasing Romanian thick and semi-thick wool fibers, their exploitation by producing nonwoven fabrics for efficient constructions, both in terms of construction costs and energy maintenance of buildings, is a good opportunity.

The valorization of coarse wool fibers Turcana for the construction field is a valuable instrument for:
- Solving the problem of wool industry,
- eco-building promoting,
- strengthening the Romanian technical textile sector by using (semi) coarse indigene wool fibers,
- increasing the entrepreneurial spirit and the capacity to attract and use the European non-reimbursable funds, especially for productive investments in rural areas.

The results will be used by the sheep breeders, wool fibers collecting centers, with the involvement of the Regional Development Agencies in the country and actors in the construction sector, in order to stimulate the regional entrepreneurial initiatives, both in non-woven textiles, and in the green construction fields.

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