ASPECTS REGARDING THE ROMANIAN WOOL FIBRES MANUFACTURING, IN ORDER TO OBTAIN INSULATION MATERIALS FOR BUILDINGS AND TO VALORIZE THIS VALUABLE RAW MATERIAL

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ABSTRACT: Having in view the sustainable development context, the textile sector represents a strong pillar of the Romanian manufacturing industry, which is able to contribute to the valorisation of natural indigenous raw materials. The paper presents the results obtained through developing/ implementing a research project financed by the National Sectorial Program, coordinated by the Romanian Ministry of Research and Innovation, aiming to establish strategic solutions for capitalization of Romanian coarse wool fibres. There are emphasized the results obtained by the collaboration of three important actors from research activity and economic environment: the National Research and Development Institute for Textiles and Leather –INCDTP Bucharest, the only one R&D Institute in Romania, SC MINET SA Company, Râmnicu Vâlcea county – a representative wool manufacturing company for nonwoven materials and the Research Institute for Sheep and Goats Breeding, Palas, Constanta county, partners in the consortium coordinated by the National Research and Development Institute in Constructions, INCERC Bucharest.

KEY WORDS: innovation, entrepreneurial initiatives, technical textiles for buildings

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 and low quality pastures, lack of support for sheep breeders. As a result, the spinnability 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, cosmetics, and pharmaceuticals is much more important, as an efficient and viable alternative for recovery and an alternative for revitalization of several economic sectors.

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 [4].

In this context, the Ministry of Research and Innovation in Romania, together with the Ministry of Agriculture, had the initiative to launch a competition for a project entitled "RESEARCH ON THE DEVELOPMENT OF CAPACITY FOR TRANSFER AND MARKETING OF RESEARCH RESULTS ON INTEGRATED EXPLOITATION OF NATURAL WOOL RESOURCES.

APPLICABILITY OF ECO-INNOVATIVE PRODUCTS BASED ON SHEEP WOOL IN THE FIELD OF CONSTRUCTIONS" in September 2017.

A multidisciplinary consortium consisting of representative research centers of industries such as textile - INCDTP Bucharest, mechanics - ICTCM Bucharest, chemical-pharmaceutical research - ICCF Bucharest, sheep breeding - ICPCOC Palas Constanta, SC MINET SA Ramnicu Valcea, SC IRECSON SA under the coordination of INCD URBAN-INCERC Bucharest ensured the critical mass of specialists in order to achieve the objectives of this project, ongoing in 2018.

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 constructions.

2. EXPERIMENTAL WORK

At present, the proportion of "Ţurcana" breed sheep is over 70% of total heads and of the wool volume after shearing, respectively.

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

- exploiting the technological equipment of the industrial partner SC MINET SA Rm. Valcea; thus two distinct technologies were used in processing: i) strengthening the fibrous material by the thermo-chemical process and ii) mechanical strengthening;
- the use of Ţurcana wools in particular; thus the fiber composition variants used were: a) 85% Ţurcana wool + 15% heat-activated adhesive fibers, b) 70% Ţurcana wool + 30% heat-activated adhesive fibers - processed using technology i), and c) 100% Ţigaie wool - processed using technology ii), respectively;
- 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 highlighted innovative aspects are the subject of patent application A/10034/2018 of July 30, 2018, entitled "Unconventional textile fabric based on wool, from Romanian breeds, for the isolation of constructions and the process of obtaining thereof", authored by SC MINET SA Rm. Valcea, INCDTP, INCD URBAN-INCERC and ICPCOC Palas, Constanta.

3. 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 beeing well known all over the world. Civil engineering and building engineering are a signifiquant 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, 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, geo-membranes 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. One of the most important objective of the mentioned project was to disseminate to all Romanian regions the eco-products usage culture. In this respect, INCDTP together with the coordinator and the other consortium partners has performed the following workshops, round tables and symposiums:

- 19.09.2018, at Orchidea Events, str. Stadionului street no.3, Sf.Gheorghe citty, Covasna county; there were attend local authorities, the Transylvania Textile & Fashion Cluster, students and professors from Technological Gymnasium Sf.Gheorghe, companies, sheeps growing associations.

This region is well known for the tradition, hystory and popular handcraft promoting and developing. The valorization of Romanian wool course fibers is one of the most signifiquant objective for this region, so the research results were very useful and interesting for the participants. The project manager Mr. Vasile Meita presented the paper called „ Researches regarding the use of wool fibers for construction domain"; also Mr. Cezar Bulacu, the research activity manager from MINET SA Rm. Valcea company, partner in the consortium, presented the paper called „SC MINET SA – representative example for valorizing through research activity of the Romanian wool fibers for the eco-building field".

Figure 1- Regional debate Sf.Gheorghe citty, Covasna county, 19.09.2018, INCERC presentation

Figure 2 - Regional debate Sf.Gheorghe citty, Covasna county, 19.09.2018, INCDTP presentation

- 9.10.2018 at Romanian Industry and Commerce Chamber, Aurel Ghibuțiu hall, there was organized by INCDTP as co-organizer The Symposium for Sustainable Developing of Textile Industry; with this occasion there had been presented the papers called: „Romanian natural fibers – a way to support the sustainable development of textile industry in Romania", „The recycling and valorization of textile waste – a way to support the sustainable development of textile industry in Romania", „Multifunctional technical textiles – achievments and trends"; The Department for Sustainable Development from The Romanian Governement was also with this occasion represented; local authorities, companies from Bucharest and Sf. Gheorghe were participated; a very nice and instructive exhibition had been organized, by local handcrafters; they are using natural Romanian fibers as raw material for popular traditional decorative homemade products;

Figure 3 – Local handcrafters exhibition, decorative hometextiles, Romanian Industry and Commerce Chamber Bucharest, 9.10.2018

Figure 4.1 – Sustainable development Symposium, Bucharest, 9.10.2018

Figure 4.2 - Sustainable development Symposium, Bucharest, 9.10.2018

Figure 4.3 - Sustainable development Symposium, Bucharest, 9.10.2018

The promoting and disseminating activity has continued at Piatra Neamt citty, on 18.10 2018, at RUBIK HUB. Mrs. Agata Filimon, representing The Nord –East Regional Development Agency, presented the paper called „The wool fibers - tradition and innovation, the intelligent valorising refinded". Also the ASTRICO NORD –East Textile Cluster activity has ben ilusstrated by the president, Mr. Serban Stratila. With this occasion the Agency for Agriculture Neamt has been represented, the discussion beeing very well conected to the specific problems and requests of the sheeps growing producers.

- On 20.11.2018, INCDTP in collaboration with Romanian Engineer's General Association - AGIR Bucharest, had been organized the workshop called "The natural resources for textile industry –present and future". With this occasion the Romanian Academy for Agricultural Science has been represented by Mr. Professor Valeriu Tabara and his team, who strongly activates for the sustainable development of Romanian natural fibers, vegetal and animal fibers, usage.

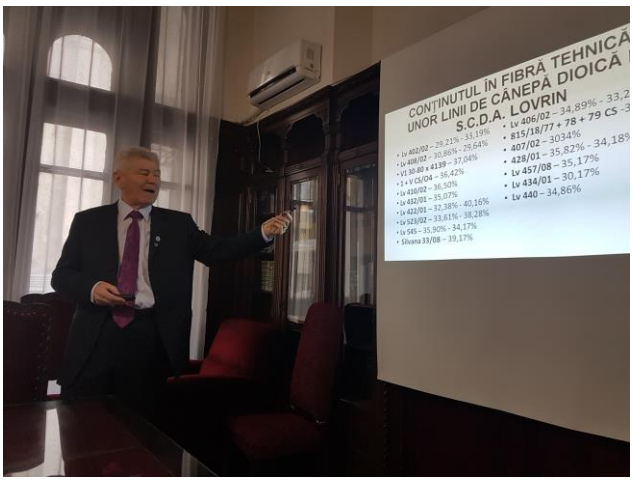

Figure 5 – "The natural resources for textile industry –present and future" Workshop, 20.11.2018, Romanian Engineer's General Association - AGIR Bucharest

All the meeting performed at regional level during this project's period have conducted to the same important conclusion: there are imperious necessary investments for wool fibers washing in Romania, clean wool fibers collecting centers and last, but not the least, companies for manufacturing this important raw indigenous material; 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.

4. ASPECTS REGARDING THE ECONOMIC EFFICIENCY

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.

These are the arguments for which we analyzed 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.

The working hypotheses (input data) from which we started in this simulation are:

- we are located in a mountainous rural area, where sheep breeding is a basic occupation of most peasant farms;

- the sheep wool is sheared once a year and the raw (greasy) wool obtained is collected and sent to a collection center (already existing in the country) to be forwarded to the wool laundry;

- the wools will be washed either at the wool laundry at SC STOFE SA Buhusi, or in cooperation with the laundries in Turkey; we highlight that an investment to set up a wool laundry is extremely costly, and involves the existence of waste water treatment plants, since it is a water impurifier; considering environmental regulations, we do not consider the possibility of washing small quantities of wool directly into rivers;

Entrepreneurial initiative starts basically from the processing of washed wools;

We also believe that the entrepreneur already owns the space and construction to open this micro-enterprise for the processing of washed wools and the production of non-woven textiles for thermal and sound insulation of buildings.

Taking into account these working hypotheses, a simulation of a business plan, based on the technical data obtained in the technological experiments carried out within the project, was conducted by SC MINET SA Ramnicu Valcea and INCDTP partners. Based on cost categories, the situation is the following:

- raw material costs (lei/kg of washed wool); costs of chemical auxiliaries used in processing, anti-insect treatment products, fire retardance treatment products (lei/kg);
- labor costs: (lei/m^2 of non-woven fabric);
- utilities costs (overheads) (lei/m^2 of non-woven fabric);
- third-party processing: testing raw material and finished products, product research and development, marketing costs, as it is a starting entrepreneurial initiative.

The production prices ranged between 19.27-37.34 lei/m^2, varying directly in proportion to the specific consumption values g/m^2 and depending on the type of washing of the raw wools used (washing it abroad is more expensive).
It should be stressed 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 spinnability 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; currently only three such companies are active in the country, therefore entrepreneurial initiatives in this field are necessary and timely;
- 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.
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.

5. CONCLUSIONS

In the conditions of increasing Romanian thick and semi-thick wools, 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 results have been disseminated in debates with representatives of sheep breeders, 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.

The strong impact that this research, carried out by a passionate, high qualified and dedicated to the subject of "valorizing of Romanian wool resources" consortium has is materialized by the following effects:

- increasing the capacity of capitalization in the non-woven textile sector of Romanian semi-thick and thick 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;
- reinvigorating the technical textile sector from Romanian semi-thick and thick wool fibers.

The project through the complex activities carried out by a multidisciplinary consortium ended with obtaining valuable results that can further contribute to the substantiation of the development decisions of the alternative fields of valorization of the natural-wool resource, with an impact on the following important areas: sheep breeding, production, collection, sorting and washing of Romanian wools, technical textile processing industry, energy efficient construction sector.

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