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LNS materials optimised

Better application possibilities for LNS natural material products

The current manufacturing method for plant stalk core materials has been further developed to give LNS (Light Natural Sandwich) products a wider application range. Behind this is a new vegetable oil based glue foam and a suitable adjusted manufacturing method for the core blanks. Digital photo processing has been introduced to test the quality control system which enables ordering of the core materials into an optimum construction.

Core material of LNS building material consists of plant stalks fixed parallel to one another with glue foam (cereal straw, Miscanthus stalks, reeds and bamboo stems). These are stalks of high stiffness and low density. The plant stalks are applied quasi as half-finished components This method saves energy in processing and enables plant synthesis performance to have a full effect in the end product. The stalks or stalk sections are contained within the core as a fibre tube structure and additionally create a honeycomb structure between the outer cover layers (*fig. 1*). The honeycomb form has proved itself in nature, and in technology (airplane construction), as very light support or core structure material.

Improving foam and the production method

A new glue foam was developed for improving the properties, especially the density, of core material. Basis is a natural soya-based polyol. Because of its other characteristics the new foam required a modified production process whereby the expansion of the glue takes place not as usual through physical or chemical propellant but instead through the injection of air via a special foaming machine. In a second expansion step vacuum is applied to further reduce glue density. The subsequent aeration takes place with hot air. The result is a glue foam that gives the required binding effect for the stalks.

For expediting the hardening process the method was further altered to include heated foam forms. The alterations led to a clear reduction in the density of the core material (to ~ 65 kg/m^3). The advancement in standardisation meant that the application of a small production robot (*fig. 2*) was then possible which injected a constant amount of glue foam between the stalks. This helped guarantee a more homogenous and thus better distribution of the foam within the stalks. In turn this gave a clear improvement in the quality and reduced rejections through poor glue distribution. The injection fitment can be adjusted and changing it can allow the different stalk shapes of the utilised plant material to be taken account of. The choice of stalk depends on the proposed use of the core material. Thus in this plant normal cereal straw can be processed as well as the thicker stalks from Miscanthus or reeds. The system also gives the possibility of varying stalk type during production.

Quality control of LNS cores through automatic digital photo processing

In order to maintain a consistently high quality of LNS material control and selection of the core material itself is required as well as selection of covering outer layers, glue and

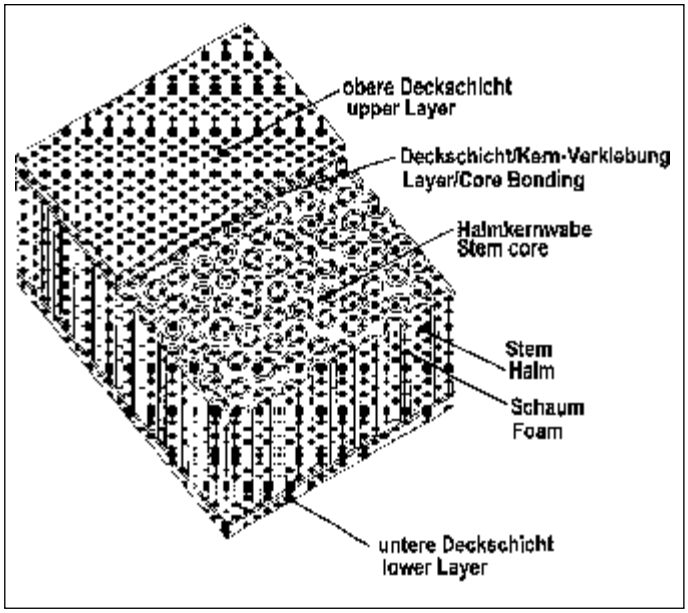

Fig. 1: Structure of LNS materials

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Keywords

LNS (Light Natural Sandwich) materials, production methods, quality control

Literature

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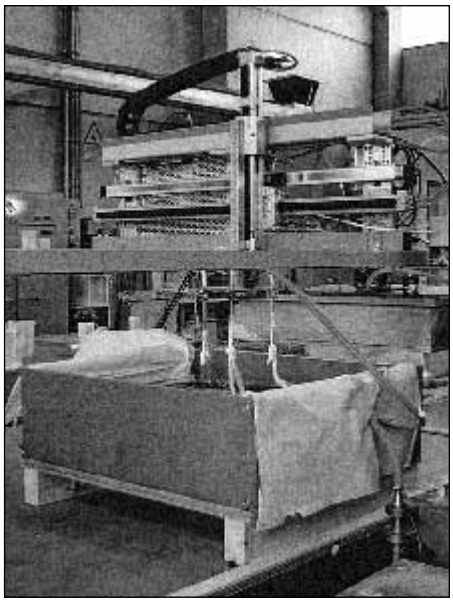

Fig. 2: Injection of foam into the straw laying in the heated form by the production roboter

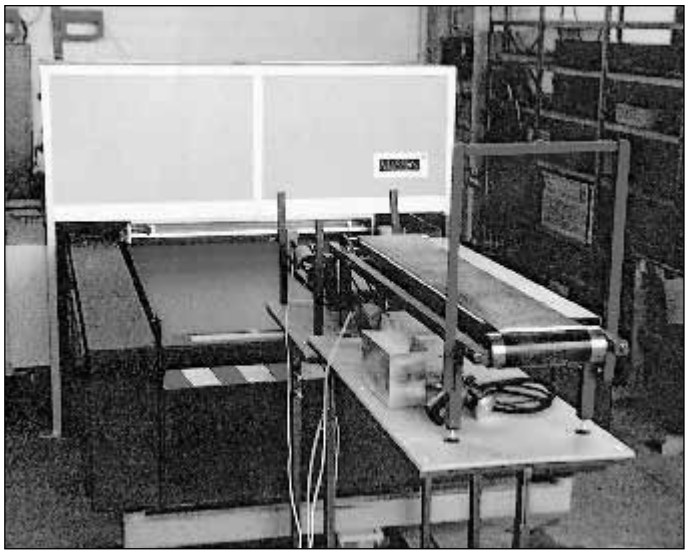

Fig. 3: Supply for quality control with digital imaging

applied stalks. This selection can take place with the help of a system for digital photo processing (*fig. 3*). Good core material is characterised by a consistent distribution of stalks and foam. These factors can be controlled during production with the utilised photo processing system The system features two digital cable cameras mounted over a conveyor belt upon which the material to be inspected is transported under the lenses. The system can determine length, breadth and surface area of objects. Additionally a separation of up to eight colours is possible. The colours to be identified by the system can interactively be learned by the system in a training phase using special software. The colours can also be applied to specific object parts of the core material allowing them to be clearly identified according to colour.

In the case reported here the colour classification of the system was so adjusted that it could identify in the core material the stalk proportion (red), foam (white) and spaces (blue) (*fig. 4*). The basic thinking here is that a good core material can be identified through containing the highest amount of stalks (red) because this ensures the stability of the LNS material. Additionally a homogenous distribution of the stalks is important. The foam proportion (white) indicating the glue between the stalks would represent a smaller part of the whole whilst holes (blue) should be barely visible because they have a negative influence on the structural stability.

Digital photographs of the material can be made with this system which serve as basis for information over colour distribution of material components for documentation of the quality of the investigated material. This gives information on the purpose for which the material is most suitable. Thus, for use in rotors of electricity-generating windmills only material of the best quality is suitable whilst for the manufacture of table elements a lower quality would be sufficient.

Summary

The planned alterations in the production of LNS materials have led to a decrease in material density. The production process was able to be at least partially automated whereby one can accept that with complete automation a further quality improvement could be expected. The process is characterised by a very high quality in the finished article. Core material can be produced on the plant for a multiplicity of uses.

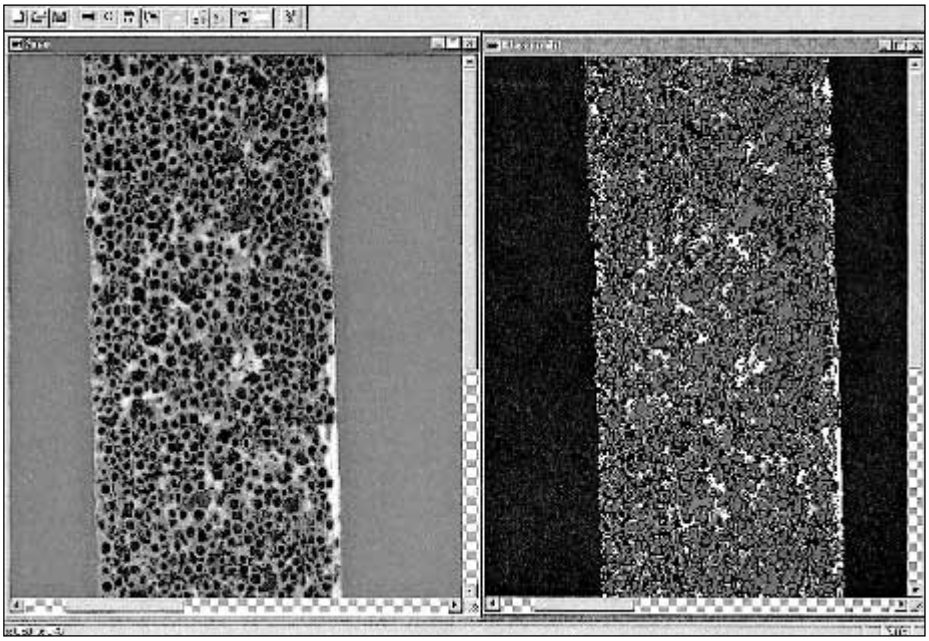

Fig. 4: Picture of a LNS-core with the corresponding color code