MÉTHOD AND DEVICE FOR HOMOGENEOUSLY HEATING MATERIALS BY MEANS OF HIGH FREQUENCY ELECTROMAGNETIC RADIATION

DESCRIPTION OF THE INVENTION

The present invention relates to a method for heating materials being capable of absorbing high-frequency electromagnetic radiation, in particular, microwaves. In contrast to conventional thermal system, the main mechanism of microwave absorption in a polymer is the reorientation of dipoles in the imposed electric field; the energy is dissipated like heating due to dipole movement. Energy is transmitted volumetrically, so temperature gradients are reduced and it is possible an internal – external curing.

One basic problem of the heating by means of high-frequency electromagnetic radiation, in particular microwaves, consists in that a rather inhomogeneous temperature distribution is achieved in the material being heated. Moreover, as heating of a material by means of high frequency electromagnetic radiation is dependent on its material properties, e.g. density, water content, material type and especially absorption capacity for high-frequency electromagnetic radiation, for this it is practically impossible to provide for a substantially homogeneous heating of the material by means of high-frequency electromagnetic radiation.

It is therefore an object of the present invention to provide for a method and a device for heating materials being capable of absorbing high-frequency electromagnetic radiation, where the mentioned drawbacks are wholly or at least partially eliminated. This method is preferably applicable for substantially homogeneously and reproducibly heating and curing or cross-linking resins or polymers, although the invention must not be regarded as being restricted to the heating of plastics materials, so the present invention may be useful for heating any material being capable of absorbing high-frequency electromagnetic radiation at least partially.

APLICATION BUSINESS SECTORS

The technology is applicable for alternative curing composite materials, especially interesting for the following sectors: Wind energy industry, Aircraft industry, shipbuilding, industry of tanks, pipes,…

TECHNICAL ADVANTAGES AND BUSINESS BENEFITS

The advantages of microwave heating in contrast to conventional heating are, among others:

- The heating of the part is volumetric. The microwaves are absorbed from the resin, which will be heated up by that energy absorption and starts crosslinking. An homogenous temperature profile and also cross-linking profile is achieved, independent of the parts thickness. Summarising, an optimisation of degree of cures with a high rate production is obtained, due to whole part starts cross linking process at same time.
- Due to previous mentioned advantage, a higher proportion of hardening of the plastic material is achieved, whereby the part can be optimized using fewer raw materials to the same mechanical requirements.
- Minimisation of thermal gradients curing and exothermic reactions, extending the service life of moulds and avoiding thermal degradation caused by high exothermic peaks.
- By avoiding temperature differences, microcracks and strains caused by the shrinkage-expansion of the material are reduced or canceled. This microcracks and strains could lead to delamination and / or breakage of the matrix.
- To avoid tensions mentioned in previous lines, conventional systems typically work at low temperatures and heating rates. This involves long cure cycles. Using microwave radiation, the increasing of the production rate (by a factor of between 2 and 5) is produced by reducing the curing time
- It can address complex parts due to volumetric heating. Curing gradient is independent of the geometry of the part, obtaining an improvement in product quality.

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- Residues are also reduced, thanks to a better control of the reaction which reduces the number of parts out of specifications.
- Reduced emissions of styrene through the use of polyester resins in the steps of injecting and curing, through the reduction of time in both phases.
- Finally, better control of the reaction and thus higher quality and lower production time are achieved.

STATUS DEVELOPED OF THE TECHNOLOGY

The process has been successfully tested at pilot plant where trials of different resins and composite materials have been carried out (polyester, vinylester, epoxy,…). The process is feasible to apply in different sector for composite processing (hand lay-up, infusion, RTM,…)

INTELLECTUAL PROPERTY RIGHTS

This technology is protected by a European patent: Method and device for homogeneously heating materials by means of high-frequency electromagnetic radiation: EP2046093B1.

COLLABORATION SOUGHT

Companies interested in the following systems of cooperation:

- Agreement about patent license to implementation and to use of technology.
- Agreement about Research & Development projects (technical cooperation) to apply technology in different sectors.

RELATED IMÁGES

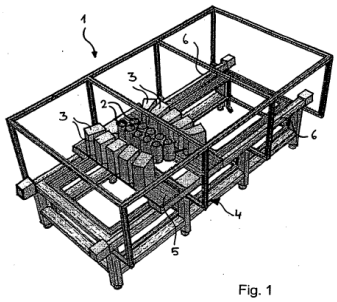

Fig. 1

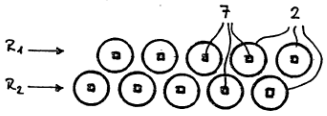

Fig. 2

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