The process shall further be useful for partially consolidating foamed materials with or without outer material. The process shall also be useful for producing hollow articles from two or more foamed materials with or without outer layers. The process shall further be modifiable such that it can be combined with a vacuum-forming operation.

Furthermore, irrespective of the individual embodiments posed as objects, the novel process shall allow fast cycle times of distinctly below 10 min.

Further objects not explicitly discussed here may become apparent hereinbelow from the prior art, the description, the claims or exemplary embodiments.

Solution

The objects are achieved by a novel process for forming foamed materials. This novel process is particularly useful for forming rigid foams as of highly crosslinked polyurethane (PU), polypropylene (PP) or of poly(meth)acrylimide, especially of polymethacrylimide (PMI). The process comprises the steps of:

a) optional composite ply layup with outer materials and a foam core thereinbetween,

b) heating the foamed material by irradiation with near infrared radiation (NIR radiation) having a wavelength between 0.78 and 1.40 µm,

c) forming with a forming tool,

d) cooling and demolding the final workpiece.

In a first aspect, there is provided a process for forming foamed materials, wherein the foamed material comprises PMI~~, PP or highly crosslinked PU~~, said process comprising the steps of:

a) optional composite ply construction with outer materials and a foam core thereinbetween,

b) heating the foamed material by irradiation with near infrared radiation (NIR radiation) having a wavelength between 0.78 and 1.40 µm,

What is claimed is:

1. A process for forming foamed materials, wherein the foamed material comprises PMI, ~~PP or highly crosslinked PU,~~ said process comprising the steps of:

    a) optional composite ply construction with outer materials and a foam core thereinbetween,

    b) heating the foamed material by irradiation with near infrared radiation (NIR radiation) having a wavelength between 0.78 and 1.40 µm,

    c) forming with a forming tool,

    d) cooling and demolding the final workpiece.

2. The process as claimed in claim 1, wherein the heating and forming takes place in two separate tools and the process comprises the steps of:

    a) optional composite ply construction with outer materials and a foam core thereinbetween,

    b1) introduction into the machine-side active region of the heating fields,

    b2) heating the foamed material by irradiation with near infrared radiation (NIR radiation) having a wavelength between 0.78 and 1.40 µm,

    c1) transferring the foamed material into a forming tool,

    c2) forming with the tool, and

    d) cooling and demolding the final workpiece.

3. The process as claimed in claim 1, wherein the heating and forming takes place in one tool and the process comprises the steps of:

    a) optional composite ply construction with outer materials and a foam core thereinbetween,

    b1) introduction into a forming tool equipped with a removable heating field,

b2) heating the foamed material by irradiation with near infrared radiation (NIR radiation) having a wavelength between 0.78 and 1.40 µm,

c1) removing the heat from the operating range of the forming tool,

c2) forming with the tool, and

d) cooling and demolding the final workpiece.

4. The process as claimed in any of claims 1 to 3, wherein step d) comprises a vacuum-forming process.

~~5. The process as claimed in any of claims 1 to 4, wherein the foamed material comprises a PMI foam.~~

~~6.~~5. The process as claimed in any of claims 1 to ~~4~~5, wherein step d) provides a local consolidation of the foamed material.

~~7.~~6. The process as claimed in any of claims 1 to ~~4~~5, wherein two or more separate pieces of the foamed material are initially charged and a hollow article is molded from these in step d).

~~8.~~7. The process as claimed in ~~either~~ claim 4 ~~or 5~~, wherein step c) is directly preceded or directly followed by preforming with compressed air.

~~9.~~8. The process as claimed in either claim 4 or ~~7~~8, wherein step a) is carried out and a fiber-reinforced plastic is used as outer material.

~~10.~~9. The process as claimed in claim ~~8~~9, wherein the plastic comprises PP, PE, PC, PVC, an epoxy resin, an isocyanate resin, an acrylate resin, a polyester or a polyamide and the fiber material comprises carbon, glass, polymeric or aramid fibers.