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5 The invention relates to a flame-resistant, noise-protection wall made of acrylic glass, comprising carriers anchored to the ground, and acrylic glass panes of, for example, 10 to 30 mm thickness, secured to said carriers.

10 Prior art

Noise-protection walls with acrylic glass panes are known; cf. German Utility Model G 92 02844. A suitable carrier system is disclosed in the German Utility Model G 85 24319.

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Such noise-protection walls must, to a limited extent, to be able to resist fire, for example a grass fire at the site of installation. This may be easily achieved during manufacture by incorporating in the acrylic glass conventional flame-resistant additives based on phosphorus or halogen compounds. Most additives, however, are a health hazard and special protective measures are therefore necessary when manufacturing and processing acrylic glass.

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Object and solution

30 The invention has the object of rendering acrylic glass panes for noise-protection walls flame-resistant, without using halogen- and phosphorus-containing additives. Observation of supplementary technical regulations for noise-protection walls ZTV-Lsw 88 laid down by the Federal Ministry of Traffic is a special requirement here.

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It has been found that this object may be achieved with an acrylic glass noise-protection wall, comprising carriers and panes secured to said carriers, if the

acrylic glass comprises, at least on the surfaces of the panes, a copolymer of methyl methacrylate which contains 1 to 20 wt.% of an alkyl acrylate or styrene, and is free from halogen- and phosphorus-containing flame-resistant additives.

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10 A test arrangement for testing the fire resistance is used, in which a wall member, surrounded by a U-shaped frame section, is placed vertically onto a 25 cm high non-combustible base. Directly in front of the front end, two 30 x 30 x 20 cm wire baskets, each filled with 600 g of wood fibre, are placed vertically on the ground at points one third and two thirds of the way along the member. After an hour, the back of the member is
15 treated in the same way. In order to pass the fire test, the wall member tested must not catch fire nor burn in parts either. There must be no fire holes larger than 6 cm² and no cracks of more than 5 cm in length.

20 Wall members according to the invention (manufactured according to Example 1) of a size of 2,000 x 1,000 x 15 mm fulfill the above fire test. In contrast, wall members of the same dimensions, made of conventionally cast acrylic glass and comprising pure polymethyl
25 methacrylate, only fulfill 50% of these test conditions. These members caught fire and had to be sprayed with water at the end of the test.

30 The finding that under the conditions of the above fire test, the acrylic glass panes according to the invention did not ignite by the time the surrounding fire finished burning is surprising because it was not expected that the incorporated acrylic or styrene comonomers would have that effect. Though an explanation has hitherto
35 not been possible, it is assumed that the risk of inflammation is due to the combustion of monomeric methyl methacrylate vapour produced by thermal depolymerisation. It appears that the depolymerisation

tendency of acrylic glass is reduced by the comonomers to such an extent that the amount of monomer vapours is not sufficient for initiating a fire.

5 The fire resistance in the above test only applies to a small depth of material. Therefore, the acrylic glass pane must comprise the copolymer mentioned at least up to this depth. It is sufficient if the copolymer forms outer layers of about 0.1 to 1 mm in thickness, while
10 the inside may be made of acrylic glass or other materials of sufficient stability which are not flame-resistant. Since the manufacture of such multi-layered panes is expensive, homogenous copolymer panes are preferred.

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Implementation of the invention

The main component of the copolymers according to the invention is, in each case, methyl methacrylate. As
20 known, the polymers which are largely synthesised therefrom are noted for a high resistance to ageing and to weathering, a characteristic which is of critical importance in noise-protection walls.

25 Suitable alkyl acrylates are, in particular, the lower alkyl esters of acrylic acid having 1 to 4 carbon atoms in the alkyl group. Higher alkyl acrylates have a plasticising effect which would make the acrylic glass pane more susceptible to mechanical damage. An amount
30 of 1 wt.% of alkyl acrylates or of styrene already has a clear effect on the resistance to fire. Preferably, 3 to 10 wt.% of comonomers are used. An amount of more than 10 wt.% does not significantly increase the effectiveness, but the plasticising effect of the alkyl
35 acrylates increases to an undesirable extent. In addition to alkyl acrylates and/or styrene further comonomers may, optionally, also be used, but this can result in disadvantageous weather-resistance properties.

It has been found that, as in the case of alkyl acrylates or styrene, terminal mercaptan groups also have a flame-resistant effect on the polymerised methyl methacrylate, but in most cases they would not, on their own, be sufficient to satisfy the fire test. However, if the copolymer according to the invention is prepared by radical polymerisation, in the presence of a mercaptan, the flame-resistant effect of the comonomers is further increased.

Mercaptans such as n-butylmercaptan, dodecylmercaptan, thioglycolic acid, mercaptoethanol, 2-ethylhexylthioglycolate, butylthioglycolate, octylthioglycolate or methyl-3-mercaptopropionate act as transfer regulators. If, during radical polymerisation, they are present in the monomer mixture comprising methyl methacrylate and alkyl acrylates and/or styrene, they are able to react with the radical chain ends of the growing polymer chain. This stops their further growth and a mercapto radical is formed which, in turn, becomes the starting point of a new polymer chain. In this way, polymer chains are produced which have the mercaptan residue as a terminal group.

The transfer effect of the mercaptans results in a decrease in the average molecular weight of the copolymer. If the decrease in the molecular weight is too great, the stability characteristics of the acrylic glass may be affected. Therefore, the amount of mercaptan is preferably limited, so that the molecular weight does not fall below an average value of 50,000. Suitable amounts of mercaptan are normally about 0.1 to 2 wt.% based on the amount of monomer.

The lower the molecular weight of the copolymer the easier the thermal processing. With molecular weights within the range of 50,000 to 200,000 the copolymer may be thermoplastically processed, thus enabling the

manufacture of suitable acrylic glass panes by extrusion or thermal compression of a polymer powder. If no mercaptan or only a little is used when preparing the polymer, the molecular weight becomes so high that the panes cannot be manufactured by extrusion or compression. In that case, they may be manufactured using the known lead-chamber process, in which the monomer mixture which comprises a radical-forming initiator, is introduced into a flat chamber formed by two glass plates and a sealing cord encircling the edge of the plate and is polymerised by heating.

In order to achieve a sufficient noise-protection effect, the acrylic glass panes must be fairly thick. With thicknesses below 10 mm, the noise-absorbing effect is not sufficient. With thicknesses of more than 30 mm, the increased effect cannot be economically justified on account of the increase in material used. Preferably, the panes should have a thickness of 12 to 25 mm. When they are prepared by polymerisation in chambers, the desired thickness may be adjusted by a correspondingly chosen thickness of the sealing cord placed between the glass walls, whilst taking account of the polymerisation-related shrinkage. The preparation of correspondingly thick panes by extrusion is difficult. A suitable extrusion nozzle is disclosed in the German Utility Model G 90 015187.

Glass-clear, colourless panes are preferred. Panes with easily visible longitudinal or transverse strips at a spacing of a few centimetres or opaque coloured panes are sometimes preferred in order to protect birds.

Special precautions are necessary in noise-protection walls near roads so that no fragments are thrown about if an acrylic glass pane is destroyed in the event of an accident. It is suggested, in the German Utility Models G 91 09817 and G 92 02488, that high tensile inserts,

which extend in the longitudinal direction and contain the fragments, be embedded in the acrylic glass panes. Suitable inserts include, for example, monofil threads or tapes made of polyamide, or steel spirals. In the chamber process, they are clamped into the flat chamber before the monomers are introduced and are then surrounded by the polymerising monomers after their introduction. When the extrusion process is used, two strands of half the thickness may be extruded separately and combined in the thermoplastic state in a roll mill, whilst the threads or bands run in simultaneously between the two strands. Here, the material used for a high tensile insert must be one that is not damaged by the high temperature of the thermoplastic strands of moulding compound.

The acrylic glass panes have the usual dimensions of 2 to 4 m length and 1 to 2 m width. Normally, they are secured to vertical supports or posts which are secured to the ground. The edges are preferably enclosed by metal U-sections.

Examples

1. Preparing a PMMA plate by extrusion

- 5 A thermoplastic moulding compound comprising a copolymer of 97 wt.% of methyl methacrylate and 3 wt.% of methyl acrylate (commercial product Plexiglas® moulding compound Y7N, Röhm GmbH), is extruded through a slot
10 dye, at a temperature of the compound of 260°C, from a single-screw degassing extruder (screw diameter D = 100 mm, length = 32D), to form a sheet of a width of 1,500 mm. The sheet is then calibrated between smoothing rollers to obtain a thickness of 18 mm.
- 15 The fire test under the above conditions was satisfied by all plates prepared.

2. Preparing a PMMA plate by chamber polymerisation

- 20 A monomer mixture comprising 93.95 parts by weight of methyl methacrylate, 6 parts by weight of methyl acrylate, 0.05 parts by weight of 2,2'-azo-bis-isobutyronitrile is introduced into a flat chamber formed by two glass panes and a sealing cord encircling
25 the edge between the panes, and polymerised in a water bath of 35°C. To complete the polymerisation, the flat chamber is then heated to 115°C for a few hours.

- 30 In the fire test on the PMMA plate produced, the plate did not catch fire or develop flames. There was no burning through or formation of cracks. In the effected area, fine bubbles and a brownish discolouring became visible.

- 35 3. Preparing a PMMA-plate by chamber polymerisation, while simultaneously using mercaptans

The procedure according to Example 2 was repeated, but

the monomer mixture also comprised 0.3 parts by weight of 2-ethylhexyl-thioglycolate. The polymerisation temperature was 45°C. In the fire test on the PMMA-plate produced, even fewer bubbles formed than in

5 Example 2.



Claims

1. A flame-resistant noise-protection wall made of acrylic glass, comprising carriers and acrylic glass
5 panes secured to said carriers, characterised in that, at least on the surfaces of the panes, the acrylic glass consists of a copolymer of methyl methacrylate containing 1 to 20 wt.% of an alkyl acrylate or styrene, and that it is free from halogen- and phosphorus-containing flame-
10 retardant additives.
2. A noise-protection wall according to Claim 1, characterised in that the copolymer contains terminal groups of a mercaptan.
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3. A noise-protection wall according to Claim 1 or 2, characterised in that the copolymer has an average molecular weight of 50,000 to 200,000.
- 20 4. A noise-protection wall according to Claim 3, characterised in that the acrylic glass panes are produced through extrusion.
- 25 5. A noise-protection wall according to one or more of Claims 1 to 4, characterised in that longitudinally extending, tension-proof inserts are embedded in the acrylic glass.