A formulation for use as a primer, a first polymeric composition or a second polymeric composition in a process of sealing a foamed rubber product or foamed plastic product, excluding foamed polystyrene products, to provide a continuous flexible, impervious surface. The formulation includes an adhesive polymeric resin. The process includes applying a primer of foam-penetrating viscosity to a surface of a foamed product, such that the primer penetrates partially into the foam cell structure at least partially coating the surface. A liquid first polymeric composition is then applied under pressure onto the primer-treated surface which effects at least partial penetration of the first polymeric composition into the product.
FORMULATIONS FOR SEALING FOAM PRODUCTS

FIELD OF INVENTION

[0001] This invention relates to formulations for sealing products, especially foam products.

BACKGROUND TO THE INVENTION

[0002] Foamed plastics are porous, very light substances made of various plastics such as epoxide resins, urea resins, polyurethane, polystyrene, polyethylene or polyvinylchloride. Phenolics, silicones and cellulose acetates can also be foamed. In fact, under the right conditions, almost any thermosetting or thermoplastic resin can be converted into a foam. Foamed plastics have a cellular structure and can be divided into foams having a closed cell structure and foams having an open cell structure.

[0003] Foams which have a closed cell structure are synthesised by incorporating a blowing agent or a propellant into the plastic which either evaporates or decomposes at the fusion point of the plastic, releasing gas bubbles which are trapped during the gelling of the plastic.

[0004] Foams which have an open cell structure are synthesised by incorporating an inert gas into the resin under pressure and then releasing the mixture to the atmosphere and curing the resulting foam.

[0005] Foams may either be flexible or rigid and have a wide variety of uses. Rigid or hard foams such as polyethylene are particularly used for thermal insulation, or furniture and building panels, whereas softer foams are used for cushioning materials, all types of padding and sponges.

[0006] Foamed rubber is a highly elastic, porous and lightweight rubber. It is made by various methods using natural or synthetic latex which is mixed with various ingredients and converted to foam. The foam rubber can also be moulded and vulcanised. Foam rubber contains approximately 85% air and, similar to foamed plastics, can be used for a wide range of consumer goods including padding for furniture, mattresses and pillows.

[0007] Inherent in the majority of uses of foamed plastic or rubber (foam) is the fact that the foam is generally required to be covered or sealed in some way, for both functional, hygienic as well as aesthetic reasons.

[0008] The covering and sealing of foam mattresses, pillows, cushions and similar products inhibits the build-up of dust and dust mites in such products. This has significant health benefits.

[0009] The covering and sealing of such foam products is particularly important in the medical healthcare industry where foam is used for mattresses, pillows, cushions, commodes and operating theatre aids, with plastic or some other covering material, purchased and stitched or made up to cover the foam for the mattresses etc. There have been increasing instances of patients in hospitals and nursing homes catching infections from such foam mattresses, pillows and cushions, due to the fact that the infection had harboured in either the stitched seams of the covering, in cracks, in ridges or indentations in the surface or had actually lodged in the foam itself.

[0010] In order to reduce the sites on the covering or foam where the bacteria can be deposited, and to prevent such problems of infection, manufacturers have attempted to provide a plastic coating which will adhere to foam and thus completely seal it.

[0011] One US manufacturer has attempted to coat foam by dipping the foam in a vat of coating. However, the method is not able to be used on open cell foams, and further, the coating has a tendency to delaminate from the foam.

[0012] Various lamination methods have also been tried to clinically seal foam products. For example, GB patent 1 588 941 (Matburn) discloses the sealing of a pad of foam material by a plurality of spray coatings of a flexible-non porous material such as polyvinylchloride (PVC), at least the final coating of which must contain electrically conductive carbon particles.

[0013] U.S. Pat. No. 4,046,587 ("Guglielmo") describes a primer composition for laminating a vinyl protective film onto a polylefinic-containing foam. The process which is described in Guglielmo is directed to the application of the primer to the foam followed by application of a polyvinyl coating by spraying or painting. The primer of Guglielmo uses chlorinated hydrocarbons, which, as noted in Guglielmo, can be quite toxic and require special handling procedures.

[0014] The present inventors have found that the above methods have either resulted in no bonding or inadequate bonding of the laminate to the foam, or a slight initial bonding which later delaminated when the total foam was sealed, resulting in the plastic laminate cover lifting from or falling off the foam.

OBJECTS OF THE INVENTION

[0015] Thus, an object of this invention is to provide a formulation used in a process for sealing foam products such that a substantially continuous, seam free, sealed surface can be obtained; and with the foam still maintaining its flexibility and its foam-like characteristics.

STATEMENT OF INVENTION

[0016] According to a first embodiment of the invention there is provided a formulation, when used as a primer, a first polymeric composition or a second polymeric composition in a process of sealing a foamed rubber product or foamed plastic product, excluding foamed polystyrene products, to provide a continuous flexible, impervious surface, which process includes:

[0017] (i) applying to a surface of said foamed product a primer of foam-penetrating viscosity, such that the primer penetrates partially into the foam cell structure at least partially coating said surface, and

[0018] (ii) applying under pressure a liquid first polymeric composition onto the primer-treated surface which effects at least partial penetration of said first polymeric composition into the product

[0019] wherein said formulation includes an adhesive polymeric resin.

[0020] According to a second embodiment of the invention there is provided a formulation, when used as a primer,
a first polymeric composition or a second polymeric composition in a process of sealing a foamed rubber product or foamed plastic product, excluding foamed polystyrene products, to provide a continuous, flexible, impervious surface, which process includes:

**0021** (i) applying to a surface of said foamed product a primer of foam-penetrating viscosity, such that the primer penetrates partially into the foam cell structure at least partially coating said surface, and

**0022** (ii) applying under pressure a liquid first polymeric composition onto the primer-treated surface which affects at least partial penetration of said first polymeric composition into the product,

**0023** wherein the primer and the first polymeric composition are applied by spraying at a pressure of between 30 psi and 80 psi, and said formulation includes an adhesive polymeric resin.

**0024** Preferably, the primer and the first polymeric composition are applied by spraying at a pressure of between about 30 psi and 80 psi, more preferably about 35 psi and 70 psi and, most preferably, at a pressure of about 60 psi. Accordingly, appropriate high pressure external atomising equipment, such as a pressurised spray gun, is generally required.

**0025** Where used in this specification, the term “psi” is taken to mean “psi (gauge)” rather than “psi (absolute”).

**0026** Preferably, at least one additional layer of a liquid second polymeric composition is also applied to the treated surface.

**0027** The primer and the first copolymer solution are preferably applied so that they penetrate to a depth of between 1 mm and 10 mm beyond the foam surface. The extent (or depth) of penetration will depend on the density of the foam. For instance, penetration in a high density foam will be less than in a low density foam. This should not affect the effectiveness of the process.

**0028** The formulation of the primer may be the same as or, preferably, different from the formulation of the first and/or second polymeric composition.

**0029** Preferably, the first polymeric composition, in association with the primer, forms a sealed layer onto which the second polymeric composition may be applied.

**0030** Preferably, the primer, the first polymeric composition and the second polymeric composition include an adhesive polymeric resin. The adhesive polymeric resin may include monomer resins, co-polymer resins or both.

**0031** More preferably, the primer, the first polymeric composition and the second polymeric composition include at least one of the following: chlorinated rubber, rubber based polymeric resins and their derivatives—including synthetics, elastomeric polyurethane, elastomeric acrylics and their derivatives including styrene acrylic, silicone and silicone derived resins and vinyl resins.

**0032** Still more preferably, the primer, the first polymeric composition and the second polymeric composition include a co-polymerised polyvinylchloride (PVC) composition.

**0033** Most preferably, the primer, the first polymeric composition and the second polymeric composition include a polyvinyl chloride/poly vinyl acetate copolymer.

**0034** The first polymeric composition and the second polymeric composition may preferably include the same adhesive polymeric resin as is included in the primer. In other respects, such as concentration of the adhesive polymeric resin and the inclusion of additives and excipients, the formulation of the primer may differ from the formulation(s) of the first and second polymeric compositions.

**0035** The formulation of the primer should be such that it is less viscous than the formulations of the first polymeric composition and the second polymeric composition. Also most preferably, the second polymeric composition includes the same adhesive polymeric resin as the first polymeric composition. The first polymeric composition may be the same as the second polymeric composition.

**0036** Preferably, the additional layers of the second polymeric composition are applied sequentially by a coat on coat process to result in a sealing coat.

**0037** Preferably, the sealing coat is built up to a thickness of at least 450 μm. More preferably, the sealing coat will be between about 450-900 μm.

**0038** The adhesive polymeric resin of the formulation of the invention may include monomer resins, co-polymer resins or both.

**0039** More preferably, the formulation includes at least one of the following: chlorinated rubber, rubber based polymeric resins and their derivatives including synthetics, elastomeric polyurethane, elastomeric acrylics and their derivatives including styrene acrylic, silicone and silicone derived resins and vinyl resins.

**0040** Still more preferably, the formulation includes a co-polymerised polyvinylchloride (PVC) composition. Most preferably, the formulation includes a polyvinyl chloride/polyvinyl acetate copolymer.

**0041** Preferably, the foamed rubber or plastic is foamed polyurethane or polyethylene, most preferably, polyurethane foam.

**0042** A further aspect is a foamed product having a substantially continuous, flexible, impervious sealed surface which has been produced according to the above process.

**0043** A still further aspect is a sealed foamed plastic or foamed rubber product, excluding foamed polystyrene products, having surfaces at least partially coated with a primer and at least one layer of a polymeric composition such that at least a majority of foam cells in the foamed product are sealed. Preferably, the surfaces of the product are substantially, or, preferably, completely coated with the primer and polymeric composition.

**0044** The process of sealing causes the polymeric coating to become integral or inherent with the foam structure itself. Thus, the sealing does not form a separate skin on top of the foam which can be lifted off the foam but, instead, the sealing occurs at least partially within the foam structure below the surface of the foam. This is understood to be due to the primer apparently forming a mechanical bond with the foam within the foam structure and the subsequent application(s) of polymeric composition(s) is understood to result in
a chemical bond with the primer. The subsequent build up of the sealing membrane film seals the foam so that it becomes substantially impervious to liquids.

[0045] Thus, the final foam product has a sealing elastomeric membrane which is integral or inherent with the foam structure itself and cannot easily be separated from the foam.

[0046] Advantageously, the sealed foam still retains its flexibility and its other general foam characteristics, yet is substantially impervious to liquids and infectious agents such as bacteria. Further, the sealed foam can be cleaned with standard antibacterial and antifungal agents, without jeopardising the imperviousness of the sealed layer.

[0047] The applications of the foam-sealing process are endless. Such areas of application will include, but will not be limited to:

- a) the medical/healthcare industry for cushions, seats, mattresses, flotation products, furniture and equipment,
- b) the marine industry for cushions, matting and protective covers including buffers,
- c) the sports industry for matting, pole surrounds and cushioning in general,
- d) the domestic industry for matting, mattresses, flotation equipment, cushions and underlays,
- e) the hospitality industry for cushions, flotation products, furniture and equipment, and
- f) the motor industry for cushions, underlays and overlays, thermal and acoustic insulation.
- g) any fabric product capable of covering foam (such as cotton, canvas and synthetic fabrics; and
- h) industry generally where foams are used.

**DETAILED DESCRIPTION OF THE INVENTION**

[0056] Foamed Plastic/Rubber

[0057] Any foamed rubber product or foamed plastic product having any standard irregular foam cell structure, whether it be open cell or closed cell, can be sealed according to the process described herein, except for polystyrene. Polystyrene is not receptive to any of the polymeric resins which can be used in the primer or in the coating compositions. The solvents in the polymeric compositions and primer in fact dissolve the polystyrene structure. While a styrene based acrylic resin could be used to seal polystyrene, the sealed foam product which results will not be flexible, but will instead be rigid. A rigid sealed foam product is generally not desirable.

[0058] Primer

[0059] The primer is required to have a viscosity which is “thin” enough such that upon pressurised application of the primer onto the foam, it can immediately penetrate through the foam surface and permeate into the foam structure. This is sometimes termed “water thin”, as the primer is effectively as thin as water.

[0060] The primer is also preferred to be fast drying. “Fast drying” effectively means that the primer should dry before it penetrates more than a few millimeters below the foam surface into the foam structure. The polymeric resins which are preferred as primers for this invention all dry within seconds of contacting and beginning to permeate through the foam structure. Of course, if the primer composition is somewhat more viscous and takes some time to penetrate past the foam surface into the foam structure, then it will not need to be so fast drying.

[0061] It is also preferred that the ingredients of the primer are chosen so that, following application and drying of the primer, the dried primer retains flexibility and resilience, so that physical characteristics of the foam are substantially maintained.

[0062] The primer can be any adhesive polymeric resin. The resin is of course incorporated with the usual acceptable excipients including solvents into the primer formulation which is applied to the foam surface. A person skilled in the art of polymeric resins would easily be able to determine an appropriate primer formulation for application in this invention.

[0063] Most effectively, the primer is applied onto and into the foam by spraying the primer, under pressure, onto the foam surface. The primer should be applied at a pressure of between about 30 psi and 80 psi. Typically, the application pressure is about 60 psi. The most preferred method of application is a pressurised spray gun.

[0064] The primer penetrates the foam structure and, at least in respect of open cell foams, surrounds the external surfaces of the foam cells present in the cellular structure. As the primer dries, it forms a layer on the outer surfaces of the foam cell walls it has contacted. Substantially all of the cells adjacent the surface of the foam have preferably been at least partially coated with the primer. Preferably the primer has penetrated and coated the foam structure to a depth of between 1 and 10 mm below the foam surface. More preferably, the penetration depth is about 4 or 5 mm. This preferred coating depth is for typical foams. The depth of the primer coating is not necessarily consistent from one foam to another as the depth will be dependant on the density of the foam. For example, for dense foams the coating depth may be no more than 1 or 2 mm, whereas for very low density foams, the coating depth may even exceed 10 mm. Further the primer layer may be of varying thickness around a cell or from one cell to another. However, the primer coating is such that the foam cells remain “cells” insofar as the coating is not intended to break open and enter the cells. Typically, the primer penetrates the foam through intercellular spaces.

[0065] First Polymeric Composition

[0066] The first polymeric composition is a liquid which also needs to be applied to the foam by spraying it, under pressure, onto the surface of the foam. It is applied onto the surface of the foam at sufficient pressure so that at least some of it penetrates below the surface of the foam. It can then bind with the primer which has also penetrated into the foam. The depth of penetration of the first polymeric composition will generally be less than the depth of the primer. The pressure at which the first polymeric composition is applied is typically the same as for the primer—namely,
between 30 psi and 80 psi. A particularly preferred application pressure is about 60 psi. The most preferred method of application is a pressurised spray gun.

[0067] The application of the first polymeric composition can occur any time after the application of the primer. In fact the primer can still be wet or it can be dry. As the primer generally dries very quickly, it will usually be dry when the first polymeric composition is applied. The first polymeric composition includes an adhesive resin which is most preferably identical to, or of the same family as, the resin which is applied in the primer. The first polymeric composition is preferably formulated so that it is significantly more viscous than the primer. The first polymeric composition is understood to form a chemical bond with the primer to form a seal which is effectively like a film or membrane. This application generally seals the majority of the foam surface. Of course the extent of the sealing is dependent on a number of factors, including the thickness of the resin used in the polymeric coating. It is possible that, if applied correctly, only one application of the first polymeric composition may be sufficient to create a sealing layer which is substantially impervious to liquids and is of at least 450 to 650 microns thick.

[0068] However, while the application of the first polymeric composition generally results in the majority of the foam surface being covered or webbed over such that a seal is formed, it is most preferable to apply further coats as described below, particularly if the application of the first polymeric composition onto the primed surface has not resulted in total sealing, to build up a sealing coat. The sealing coat is in the form of an elastomeric membrane due to the usage of an adhesive resin.

[0069] Second Polymeric Composition

[0070] While after the application of the first polymeric composition onto the foam surface, a seal has generally formed, it is possible that the seal is either somewhat fragile or, in an exceptional case, not complete. It is then preferable to sequentially apply one or more further coats of a second polymeric composition onto the surface of the sealed foam structure. This application can occur at any time after the application of the first polymeric composition. The subsequent applications need not be done under pressure and can be applied by use of a spray gun, painting, dipping or other appropriate methods. Although, preferably, it is applied under pressure.

[0071] Further, it is preferred that this second polymeric composition is the same as or includes the same polymeric resin as the first polymeric composition. In this way, a seal is built up which preferably consists of primer, first polymeric and second polymeric compositions which preferably all include an identical adhesive resin.

[0072] 450 μm is the preferred minimum thickness of the membrane seal built up by the coat on coat application of the second polymeric composition. It is particularly preferred that coats of the second polymeric composition are applied until the thickness of the membrane is between 450 and 900 μm.

[0073] An adhesive resin is of course incorporated with the usual acceptable additives and excipients including solvents into the first and second polymeric compositions which are applied. A person skilled in the art of polymeric resins would easily be able to determine the appropriate polymeric compositions for application in this invention.

DESCRIPTION OF PREFERRED EMBODIMENT OF INVENTION

[0074] A preferred embodiment of the process according to the first aspect of this invention will now be described.

[0075] A piece of flexible polyurethane foam of any thickness and size is taken. Any moisture or surface contamination (such as dirt, dust or grease) should be removed.

[0076] The foam should then be placed in such a way that application can be executed readily from any angle.

[0077] Primer containing polyvinylchloride/polyvinylacetate copolymer is then applied by pressurised spraying the surface of the foam. The spraying pressure is typically about 60 psi. It is recommended that, during application of the primer, a continuous pressure of about 60 psi is maintained on the air line at the spray gun and about 40 psi is maintained on the fluid line, to ensure adequate atomisation of the material. It is preferred that, when applying the primer, the spray gun is held about 20 to 25 cm directly above the surface being sprayed. At this relatively low height, significant penetration of the primer occurs. This copolymer immediately permeates into the structure of the foam and, being a fast-drying adhesive, generally penetrates no more than about 2-5 mm into the foam before it dries and adheres in the foam (forming a mechanical bond with the foam).

[0078] A pressure spray gun or any other high pressure external atomising equipment is filled, for convenience, with a polymeric composition containing the same copolymer. At any time after applying the primer, preferably at least 10 minutes later, the polymeric composition is applied under pressure onto the foam surface across its entire surface area. A good heavy layer of the polymeric composition should be applied to the primed area.

[0079] It is also recommended that, during application of the primer, a continuous pressure of about 60 psi is maintained on the air line at the spray gun and about 40 psi is maintained on the fluid line. This should ensure adequate atomisation for an even, smooth finish.

[0080] For best results, the first polymeric composition should be applied in a first set of parallel passes, such as up, down, up, down etc, with each pass overlapping the previous pass by about 50%, followed by a second set of parallel passes, perpendicular to the first set, such as left to right, right to left etc.

[0081] The method of applying by parallel passes, as described above, should also be adopted in all coatings of the second polymeric composition.

[0082] When the first and second polymeric compositions are being applied, it is preferred that the spray gun is held directly above and about 30-60 cm from the surface of the foam.

[0083] The nozzle of the spray gun is typically adapted so that when the spray gun is held 30-60 cm from the surface of the foam, the cross-section of the spray hitting the surface defines a rectangle of about 2.5 cmx10 cm.

[0084] If it is necessary to provide “webbing” (for instance, to provide a cover over any significant holes or
The high build elastomeric membrane which is formed has the ability to bridge holes in the foam. Once the dry membrane coat is 450 microns thick, it is impervious to liquids and most gases. At 550 microns, the membrane is tensile with total elasticity. At 950 microns, the membrane is substantially impervious to everything but Freon gas.

Manufacture of Formulations

The formulations of the present invention, are generally manufactured in a heated jacketed, medium speed closed mixing vessel. A multi-step process is usually performed in the manufacture of the formulations which can generally be described as follows:

1. Step one—Pump in solvents according to formulation.
2. Step two—Slowly add in resins while the mixer is on.
3. Step three—Start heating the vessel to a maximum of 60°C over three hours.
4. Step four—Add plasticisers and stabilisers during the heating process.
5. Step five—Once the mix is up to specified temperature, allow it to continue stirring for one hour before adding any other component. This allows the components to fuse or bind together, and is called copolymerisation.
6. Step six—SLOWLY add pigments and fillers which have been prepared as a premix.
7. Step seven—Add all other additives and allow to continue stirring for one hour.
8. The formulation should not be canned until it has cooled to ambient temperature.

Examples

Suitable examples of formulations of invention are given below. The numerals given in the third columns (below) correspond with the relevant process step at which the relevant components are added to the formulation during manufacture (as described above under the heading “Manufacture of Formulations”).

Example 1

A formulation which is particularly suitable for use as a primer is set out below.

Example 2

Another formulation for use as a primer is given below.

Example 3

An example of a preferred polymeric composition for both the first and second polymeric compositions is given below.

Example 4

Another suitable formulation for use as a polymeric composition in the process is as follows.
COMPONENTS | (Kgs/100 L) | PROCESS STEP
--- | --- | ---
Toluol | 16.75 | 1
Xylool | 16.75 | 1
Methylisobutylketone | 32.50 | 1
Union Carbide WYHH | 14.50 | 2
Tri isominate | 3.20 | 4
Dibasic lead phosphate | 2.30 | 4
Tinocia 1130 | .70 | 4
Biophenol A | .32 | 4
Tion 575 | 3.90 | 6
Alcolene S | .32 | 6
Corflex 880 | 1.30 | 6
Methylisobutylketone | 3.20 | 6

[0101] A particularly preferred primer is “POLYERGIC Primer 200™”, which is a water clear, low viscosity, fast-drying primer.

[0102] A particularly preferred polymeric composition is “POLYERGIC™” membrane covering.

[0103] It will be appreciated that, although the process has been described in relation to foams, the process can be used successfully in coating other substrates having a degree of porosity, including fiberglass, textiles and timber.

What is claimed is:

1. A formulation, when used as a primer, a first polymeric composition or a second polymeric composition in a process of sealing a foamed rubber product or foamed plastic product, excluding foamed polystyrene products, to provide a continuous flexible, impervious surface, which process includes:

   (iii) applying to a surface of said foamed product a primer of foam-penetrating viscosity, such that the primer penetrates partially into the foam cell structure at least partially coating said surface, and

   (iv) applying under pressure a liquid first polymeric composition onto the primer-treated surface which effects at least partial penetration of said first polymeric composition into the product, wherein said formulation includes an adhesive polymeric resin.

2. A formulation according to claim 1 including an adhesive monomeric resin or an adhesive co-polymeric resin or both.

3. A formulation according to claim 1 including at least one of the following: chlorinated rubber, rubber based polymeric resins and their derivatives and synthetics, elastomeric polyurethane, elastomeric acrylics and their derivatives including styrene acrylic, silicone and silicone derived resins and vinyl resins.

4. A formulation according to claim 1 including a co-polymerised polyvinylchloride (PVC) composition.

5. A formulation according to claim 1 including a polyvinylchloride/polyvinylacetate co-polymer.

6. A formulation according to claim 1, having a viscosity such that, when used as a primer, the formulation is adapted to penetrate the product to a depth of between 1 mm and 10 mm below the surface.

7. A formulation according to claim 1 wherein the viscosity of the formulation is such that the formulation penetrates the product to a depth of between 2 to 5 mm below the surface.

8. A formulation, when used as a primer, a first polymeric composition or a second polymeric composition in a process of sealing a foamed rubber product or foamed plastic product, excluding foamed polystyrene products, to provide a continuous flexible, impervious surface, which process includes:

   (iii) applying to a surface of said foamed product a primer of foam-penetrating viscosity, such that the primer penetrates partially into the foam cell structure at least partially coating said surface, and

   (iv) applying under pressure a liquid first polymeric composition onto the primer-treated surface which effects at least partial penetration of said first polymeric composition into the product, wherein the primer and the first polymeric composition are applied by spraying at a pressure of between 30 psi and 80 psi, and said formulation includes an adhesive polymeric resin.

9. A formulation according to claim 8 including an adhesive monomeric resin or an adhesive co-polymeric resin or both.

10. A formulation according to claim 8 including at least one of the following: chlorinated rubber, rubber based polymeric resins and their derivatives and synthetics, elastomeric polyurethane, elastomeric acrylics and their derivatives including styrene acrylic, silicone and silicone derived resins and vinyl resins.

11. A formulation according to claim 8 including a co-polymerised polyvinylchloride (PVC) composition.

12. A formulation according to claim 8 including a polyvinylchloride/polyvinylacetate co-polymer.

13. A formulation according to claim 8, having a viscosity such that, when used as a primer, the formulation is adapted to penetrate the product to a depth of between 1 mm and 10 mm below the surface.

14. A formulation according to claim 8 wherein the viscosity of the formulation is such that the formulation penetrates the product to a depth of between 2 to 5 mm below the surface.

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