**Method of constructing articles from polyvinyl alcohol components**

A method of construction of articles for creativity enhancement, imaginative play, craft, two dimensional modelling, three dimensional modelling or design projects is disclosed, which enables moulded organic polymer compositions comprising a polyvinyl alcohol (PVA, PVAc) base or polyvinyl alcohol with inorganic filler additions to be used. The inorganic filler comprises of calcium carbonate or wood. The moulded organic polymer compositions contactual surfaces must be smooth, free from porosity for intact bonding. The method of construction comprises of bonding moulded organic polymer compositions by water or moisture activation of the surface to bond to itself or other substances such as paper or wood to form an arts or creativity project. The present invention is biodegradable, non toxic and environmentally friendly.
Method of construction of articles from moulded organic polymer compositions for arts, toys, modelling kits, games, craft, construction kit, creativity and design projects

Description

The present invention disclosed relates to method of construction of articles from moulded organic polymer compositions comprising of a polyvinyl alcohol (PVOH) or PVOH with inorganic filler additions. The articles for project are selected from arts, modelling kits, games, craft, construction kits, creativity, design projects, greeting cards, printed craft items, jewellery items, plastic ties, furniture mould biscuits, hobby craft beads or blocks, architectural model designs, photo frames and general toys.

Many areas of industry create polymer based products for toys, creativity products, games, craft which are non-biodegradable, only leaving one choice for the material which is to be disposed in landfills. In addition, there is a need to use glue, which can either be toxic or very messy.

The launch of new environmental regulations, social concerns, and growing environmental awareness has triggered a noticeable pattern in industry to develop products and processes compatible with the environmental issues and ethical codes. This encourages the issue of designing products that integrates material design concepts with ultimate disposability. With this demand a processing method utilising, moulded organic polymer has been established to meet creativity, design and build challenges.

Presently available are many approaches to creativity, design and build projects. Most of these involve glue which can be either toxic or messy, and a wide choice of craft materials ranging from paper, plastics, ceramics or metals.

The procedure highlighted in this invention for constructing arts or creativity articles will compose of the following steps: selection of particular moulded organic polymer composition comprising a polyvinyl alcohol grade; cutting to size a plurality of the moulded organic polymer composition grades if in the sheet form or profile, if however, injection moulded, vacuum formed use directly; contactual face to be bonded is simply wetted; wet one contactual face and leave the other corresponding face dry or wet both faces; press the dry and wet face together or both wet faces together to stick the pieces together; connecting all parts in this manner completes the arts / creativity project.

The procedure described in this invention requires no glue as mentioned already and with creative imagination one can make any two dimensional or three dimensional articles. Additionally, by choosing the correct combinations of moulded organic polymers or other materials mentioned one can build scenes or create pictures. For example, air fix model kits can be completed by a younger age group, as there is no need for any toxic glue. Presently, air fix kits are either slot fitted or need to be glued together using toxic grade glues and made from plastic that is harmful to the environment.

The function of water in activating bonding in the invention disclosed is as follows: the PVOH is a water soluble polymer, while joining the PVOH composites with the water; the surface of the adhered PVOH material dissolves and it mixes with the water forming a PVOH adhesive viscous solution which bonds with that parent material when it is dried. Evaporation and cure can take place in the open under ambient, non-thermal conditions.
The material of the present invention is composed of moulded organic polymer compositions comprising polyvinyl alcohol base, described in WO 00/12615 and US6080346. PVOH has a CAS number 25213-24-5 and the material is not classified as being a dangerous preparation. The density ranges from 706 g/cm³ – 712 g/cm³ and has been available since 1924, when it was synthesised via the saponification of poly(vinyl acetate) as first described by Herman and Haehnel. Initial, application for PVOH was in textile sizing. PVOH is fully biodegradable as defined in the aqueous aerobic biodegradation test (strum test) outlined in the European Standard pr EN13432. Polyvinyl alcohol are hydrophilic biodegradable polymers, which are not only permeable to water but also to hydrated salts. Polyvinyl alcohol is used industrially in various applications, usually where the adhesive property to polar substances and high mechanical properties of this material are required. It is known to have good film forming qualities. The film qualities mean that it is widely used in the food industry as packaging and binding of pigments and fibres, dip coated articles, protective strippable coatings, the production of detergents and cleansing agents, adhesives, emulsion paints and solution cast film.

The reported aspect of PVOH involves the use of the polymer in solution, since the thermal degradation characteristics of PVOH limits its ability to be applicable as a conventional thermoplastic. PVOH (unplasticised) thermally disintegrate at temperatures of around 150°C, with the configuration of conjugated double bonds and the release of water. Crystalline melting point of PVOH ranges from 180°C to 240°C and its use as a thermoplastic, processable on conventional thermoplastic processing (melt processing) equipment, is limited unless it can be plasticized as reported in patents WO 00/12615 and US6080346 to such an extent that thermal dryness is eliminated.

Cast film described in the invention is produced by casting a solution of polyvinyl alcohol that has plasticisers incorporated. The cast flakes are then deposited onto a moving metal band which then undergoes drying, stripping from the band and secondary drying before winding into master rolls. The films contain polyol type plasticisers and are regarded as non-hazardous as well as completely biodegradable / compostable. PVOH properties are largely controlled by hydrogen bonding, resulting from the high hydroxyl group content, and its ability to crystallise, as described earlier. Depending on the degree of hydrolysis, i.e. the proportion of unhydrolysed acetate groups remaining, materials with different property combinations may be obtained, varying from partially to fully hydrolysed.

Polyvinyl alcohol grades are activated by water in either the cold, warm or hot form to initiate bonding, dependent on the particular grades involved. Moulded partially hydrolysed polyvinyl alcohol composition grades is activated via cold, warm or hot water or moisture containing substances for full adhesive behaviour; fully hydrolysed, however, via using warm or hot water or warm or hot moisture containing substances for full adhesive behaviour. Choice of grade is essential in selection of good bond strength to itself, paper or wood for arts, design or creativity projects. Examples of typical compositions described in the invention include the following compositions which are described also in WO 00/12615 and US6080346. The first composition comprising by weight, up to 50 to 60% filler, 0.5 to 2.5% lubricant, 5 to 15% plasticiser and 40-80% organic polymer composition. The second composition comprising principally organic polymer composition supplemented with 13 to 27 wt% plasticisers, 3 to 7% water, 10 to 20% glycerol of the total weight of the composition

Polyvinyl alcohol is a hydrophilic polymer and the plasticisers used in the film manufacture also have an affinity for water. PVOH tends to absorb moisture from a humid atmosphere and give up moisture to a dry atmosphere. As moisture content increases with humidity, the sheet, moulded items or built products will tend to become softer and more elastic, losing tensile properties and increasing in ultimate elongation.
The fillers described in the present invention used were to reduce the cost of the final moulded organic polymer compositions. In addition, the compounding of these fillers with these moulded organic polymer results in improved mechanical properties. However, those that do not contain a form of filler have poor mechanical properties, usually with low tensile strength. The fillers used in the invention were wood and calcium carbonate.

The wood flour was fine ground down wood particles which are a type of lignocelluloses material; these can be added to the polyvinyl alcohol in the form of filler. The use of this as filler has the ability to increase the mechanical properties of the PVOH, and also help to make a fully biodegradable plastic in which all of the material can be degraded over a period of time where other polymer fillers may be left behind after the plastic has degraded. The other recognised advantages of using this filler has also been the low density, high stiffness, decreasing wear on the manufacturing combined with biodegradable properties, and may not produce toxic by-products when burnt. The disadvantages to this filler include the high water absorption rates or de-sorption when they are placed in an environment which is subjected to changes in the relative humidity.

The other filler disclosed is calcium carbonate with a chemical formula CaCO₃. Commonly it is used as a calcium supplement or as an antacid. It is usually widely used as filler in plastics, as described in WO 00/12615 for PVOH, to improve strength and reduce cost.

The surface finish of the moulded organic polymer composition disclosed in this invention, either in sheet, extruded, vacuum formed or compression moulded during joining must be smooth, free from porosity for intact bonding to itself or paper or wood. This will ensure articles manufactured with a strong structure. However, if the material is not correctly processed, especially the time and temperature of moulding and if too much of the internal plasticiser burns out during processing, the adhesive strength is affected leading to poor adhesion to itself, wood or paper.

The strategy for construction disclosed will make learning more creative and fun. PVOH film readily accepts both water-soluble and solvent-based inks without the need for surface treatment. Conventional printing processes may be used. For most packaging applications requiring water solubility, water-based inks are preferred because they will rapidly solubilised or disperse. Manually, one can apply normal water based inks for creativeness or using felt tip, powdered inks is acceptable too. The water initiates surface of material to turn into an adhesive to accept the powdered particles. The items designed can be used for team building developments, add a bit of excitement, free up mums/dad time for children to be engaged in creative, fun and exciting activities. Project will stress the imagination, creativity of individuals and instil confidence.

The moulded organic polymer composition disclosed comprising of PVOH with special characteristic feature include degradation by over 50 species of microorganisms (bacteria, yeast and molds) typically found in compost, soil and activated sludge wastewater treatment. PVOH will completely biodegrade when composted and, when solubilised.
Claims

1. Method of construction of articles from moulded organic polymer compositions comprising of a polyvinyl alcohol.

2. The method of claim 1, wherein the procedure for constructing an arts or creativity project will comprise of the following steps: selection of the particular moulded organic polymer composition; cutting to size a plurality of the moulded organic polymer composition grades if in the sheet form or profile, if however, injection moulded, vacuum formed use directly; contactual face to be bonded is wetted; wet one contactual face and leave the other corresponding face dry or wet both faces; press the dry and wet face together or both wet faces together to form intact bonding; connecting all parts in this manner completes the arts / creativity project.

3. The method of claim 1, wherein moulded organic polymer composition comprising a cast or melt processed polyvinyl alcohol.

4. The method of claim 2, wherein, the moulded organic polymer compositions contactual surfaces must be smooth, free from porosity for intact bonding.

5. The method of claim 3, wherein the cast or melt processed moulded organic polymer composition is selected from a group comprising a partially or fully hydrolysed polyvinyl alcohol.

6. The method of claim 1, wherein the articles for project are selected from arts, modelling kits, games, craft, construction kits, creativity, design projects, greeting cards, printed craft items, jewellery items, plastic ties, furniture mould biscuits, hobby craft beads or blocks, architectural model designs, photo frames and general toys.

7. The method of claim 2, wherein the partially hydrolysed polyvinyl alcohol has better strength than fully hydrolysed polyvinyl alcohol in forming finished articles for arts, creativity or design projects.

8. The method of claim 5, wherein the moulded partially hydrolysed polyvinyl alcohol composition grades is activated via cold, warm or hot water or moisture containing substances for full adhesive behaviour; fully hydrolysed via using warm or hot water or warm or hot moisture containing substances for full adhesive behaviour.

9. The method of claim 6, wherein the moulded organic polymer composition articles comprising of a variety of choice colours.

10. The method of claim 1, wherein the moulded organic polymer composition is either formed via injection moulding, extrusion, vacuum forming, compression or any other moulding methods for construction into suitable articles; respectively moulding processing temperature should be in the range 160°C - 240°C.

11. The method of claim 3, wherein the moulded organic polymer composition comprises of a blend of organic polymer composition plus fillers.
12. The method of claim 11, wherein the filler is selected from a group of inert inorganic material.

13. The method according to claim 12, wherein the inert inorganic filler comprises of calcium carbonate or wood.

14. The method according to claim 11, comprising by weight, up to 50 to 60% filler, 0.5 to 2.5% lubricant, 5 to 15% plasticiser and 40-80% organic polymer composition.

15. The method according to claim 11 comprising principally organic polymer composition supplemented with 13 to 27 wt% plasticiser, 3 to 7% water, and 10 to 20% glycerol of the total weight of the composition.

16. The method of claim 1, wherein the moulded organic polymer composition of the various grades will bond to itself or any other surfaces such as wood, paper or any other hydrophobic surfaces if activated via water, moisture or moisture containing substances.

17. A composition according to claim 14, 15 wherein the lubricant comprises a fatty acid amide.

18. The method of claim 1, wherein articles made can be printed via water inks or sublimation processing techniques.

19. The method of claim 2, wherein can use polyvinyl alcohol based glue additional to activating with aqua or moisture processes to strengthen bonding in articles.

20. The method of claim 1, wherein articles made can be washed or disposed according to environmental regulations.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<td>US 2008/073022 A ABBOTT See whole document disclosing joining PVA parts by wetting the surface with PVA.</td>
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the IPC:

B29C

The following online and other databases have been used in the preparation of this search report:

WPI, EPDOC, INTERNET

International Classification:

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