(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 August 2012 (16.08.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/108846 A1

(51) International Patent Classification:
C08K 7/00 (2006.01) *C08L 61/00* (2006.01)

(21) International Application Number:
PCT/TH2012/000007

(22) International Filing Date:
10 February 2012 (10.02.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PCT/TH2011/000003
10 February 2011 (10.02.2011) TH

(71) Applicant *(for all designated States except US)*: **SCG CHEMICALS CO., LTD.** [TH/TH]; 1 Siam Cement Road, Bangsue Sub-district, Bangsue District, Bangkok 10800 (TH).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **TOVICHAYATHAMRONG, Chaiwat** [TH/TH]; 5/2 I-Nueng Road, Amphoe Muang, Rayong 21000 (TH). **ANUVAREEPONG, Ketthip** [TH/TH]; 5/2 I-Nueng Road, Amphoe Muang, Rayong 21000 (TH).

(74) Agents: **DUANGMANEE, Vikran** et al.; 1 Siam Cement Road, Bangsue Sub-district, Bangsue District, Bangkok 10800 (TH).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

[Continued on next page]

(54) Title: A MELAMINE FORMALDEHYDE COMPOSITION OF ENHANCEDMICROWAVE RESISTANCE AND A METHOD FOR THE PREPARATIONTHEREOF

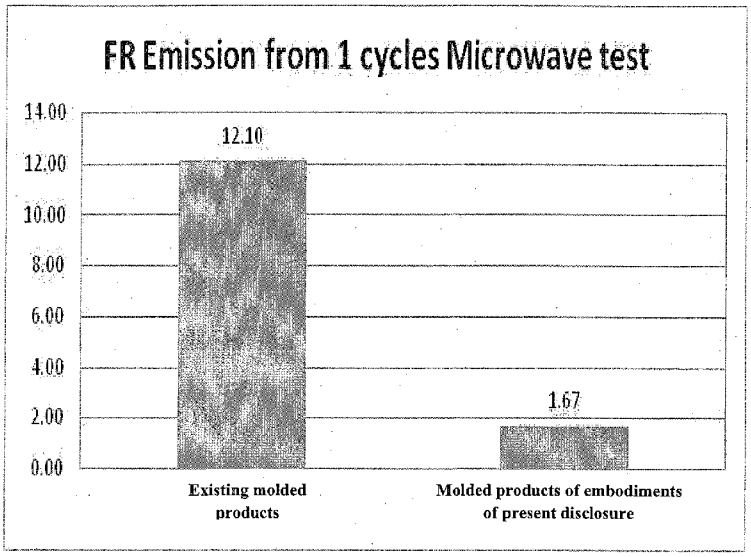

FIG. 2

(57) Abstract: A method for preparing a melamine formaldehyde molding composition and use of said melamine formaldehyde molding composition for manufacturing or producing molded products such as tableware and kitchen utensils. The method includes mixing of cured melamine formaldehyde resin and partially cured melamine formaldehyde resin. In addition, a curing agent and/or a lubricating agent can be added to the mix of cured melamine formaldehyde and partially cured melamine formaldehyde. The melamine formaldehyde molding composition includes between approximately 15% and 50% by weight of cured melamine formaldehyde resin and between 85% and 50% respectively by weight of partially cured melamine formaldehyde resin. The melamine formaldehyde molding composition can be used to manufacture cured products of enhanced resistance to microwave radiation.

WO 2012/108846 A1

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A MELAMINE FORMALDEHYDE COMPOSITION OF ENHANCEDMICROWAVE RESISTANCE AND A METHOD FOR THE PREPARATIONTHEREOF

Technical Field

The present disclosure relates to melamine formaldehyde compositions or melamine formaldehyde molding compositions that include cured melamine formaldehyde resins, compositions, or compounds as a reinforcing agent. A method for producing or preparing such melamine formaldehyde molding compositions is also provided according to various embodiments of the present disclosure.

Background

Melamine formaldehyde resins, compositions, or compounds belong to a class of synthetic resins that are made from melamine, which is a crystalline solid derived from urea, and formaldehyde, which is a highly reactive gas obtained from methanol. To form melamine formaldehyde resins, melamine and formaldehyde undergo a polymerization reaction, more specifically an aldehyde condensation polymerisation reaction, in which melamine and formaldehyde are polymerised into a thermosetting network of interconnected molecules.

Melamine formaldehyde resins or compositions generally have high solvent and chemical resistance as well as a good hardness rating. In addition, color(s) can easily be added to melamine formaldehyde resins. Melamine formaldehyde resins are widely used in the plastics molding, coating, and lamination fields. For instance, melamine formaldehyde resins are often used to manufacture tableware, kitchen utensils, and other household items.

However, tableware and kitchen utensils made from many existing melamine formaldehyde resins or compositions are typically not microwave safe. This is because many existing melamine formaldehyde resins or compositions include pulp as a reinforcement agent. When exposed to microwave radiation, this pulp reinforcement agent tend to absorb the microwave radiation or energy, thereby heating up and burning, and hence leave blackened or burnt marks on the tableware or kitchen utensils.

In attempt to solve the above-mentioned problem, the pulp reinforcement agent has been replaced with other reinforcement agents. For instance, Japanese patent application JP2003246912A discloses the use of polyethylene terephthalate resin as a reinforcement agent for manufacture or preparation of a melamine resin molding compound. JP2003246912A discloses that a preferred composition of the melamine resin molding compound includes at least approximately 60% by mass of melamine resin, between approximately 20%-40% by mass of polyethylene terephthalate resin, between approximately 5% and 10% of glass fiber, between approximately 0.1%-1% of silane coupling agents and a small quantity of a mineral filler.

Japanese patent application JP2000129083A discloses the use of powdered pulp and barium sulphate as a reinforcement agent for manufacturing or preparing melamine formaldehyde resins or compositions. The melamine formaldehyde resin of JP2000129083A includes between approximately 40%-55% by weight of melamine resin, between approximately 10%-25% by weight of powdered pulp, between approximately 20%-40% by weight of barium sulphate, and approximately 10% by weight of glass fiber.

However, the combination of different types of substances in the manufacture ofmelamine formaldehyde resins can cause resulting molding products made from such melamine formaldehyde resins to be fragile and less moldable. Furthermore, additional compatibilizer(s) will be needed for the combination of different types of substances, thereby increasing the cost of manufacturing melamine formaldehyde resins and resulting molding products made from such melamine formaldehyde resins.

US 2009/0111902 A1 is directed to a method of forming a barrier for a building and a respective barrier. The barrier comprises a first component including one or more functionalized resins selected from a functionalized water dispersible resin and a functionalized water-soluble resin, and a second component including a cross-linking agent that crosslinks at or about room temperature. While melamine formaldehyde is disclosed as a possible cross-linking agent only, there is no disclosure that a melamine formaldehyde molding composition as such shall be prepared. There are disclosed polymeric products of acrylic or SBR latices which can be cross-linked by use of melamine formaldehyde cross-linking agents.

US 2006/0079637 A1 is related to a high-solids primer composition comprising a film-forming binder and pigments, wherein the binder contains a cycloaliphatic or polycycloaliphatic epoxy resin, at least one reactive diluent and an effective amount of curing catalyst, wherein the binder may further contain a melamine cross-linking agent.

This document does not disclose a method for preparing a mixture of cured melamine formaldehyde resin and partially cured melamine formaldehyde resin, but the melamine formaldehyde is just utilized as cross-linking agent.

WO 2005/073266 A1 is directed to an aminoplast resin system, especially a melamine formaldehyde resin, wherein a modified aminoplast resin matrix is provided wherein the primary aminoplast condensation products are present at least partially in an etherified form. The system described further contains a flame retardant component selected from phosphorus, nitrogen and/or boron in chemically bonded form.

WO 03/060001 A2 discloses a composition comprising an UV stabilizing composition comprising an ortho-hydroxytris-aryl-s-triazine compound, a hindered hydroxyl benzoate compound and a hindered amine compound containing a specific radical. Ortho-hydroxytris-aryl-s-triazine is different from the well known melamine being an organic base and a trimer of cyanamide.

WO 02/062885 A2 is directed to a specific polymeric article comprising at least one polymeric material and a sufficient amount of at least one very specific compound as disclosed in formula I, II or III of this document, but no relation to melamine formaldehyde molding compositions or processes for its preparation can be seen.

EP 0 604 922 A1 provides an acid catalyst curable composition comprising a polyfunctional hydroxyl group containing material, a triazinetris-carbamate and an acid cure catalyst. Triazinetris-carbamate is not to be considered to fall under the general definition of melamine.

DE 27 35 418 is directed to a composite mold consisting of expanded perlite particlesm and a urea-melamine-formaldehyde resin modified by means of a metal. Modified urea-melamine-formaldehyde resins are different from the melamine formaldehyde molding compositions according to the present invention.

There is a need for new, enhanced, and/or improved melamine formaldehyde resins or compositions for manufacturing or producing melamine products (or melamine formaldehyde products) with desired or target properties and/or characteristics, for example increased hardness and/or resistance to microwave radiation or energy. Cost effective, safe, and efficient methods and/or processes for manufacturing or preparing such new, enhanced, and/or improved melamine formaldehyde resins are also required. Especially, the melamine products shall have an increased resistance to decoloration and deformation upon exposure to microwave energy.

Summary

This object is achieved by the subject-matter of the independent claims. Preferred embodiments are disclosed in the sub-claims. In accordance with a first aspect of the present disclosure, there is disclosed a method for preparing a melamine formaldehyde molding composition. The method includes providing a cured melamine formaldehyde resin, the cured melamine formaldehyde resin including at least approximately 85% of cross-linked molecules, and mixing a partially cured melamine formaldehyde resin with the cured melamine formaldehyde.

The partially cured melamine formaldehyde resin is prepared by heating an uncured melamine formaldehyde resin to a temperature of between 100°C and 140°C. The partially cured melamine formaldehyde resin includes less than approximately 70% of cross-linked molecules. The method involves mixing between approximately 15% and 50% by weight of the cured melamine formaldehyde resin with between approximately 85%) and 50% respectively by weight of the partially cured melamine formaldehyde.

In accordance with a second aspect of the present disclosure, there is disclosed a melamine formaldehyde molding composition that includes between approximately 50% and 85% by weight of a partially cured melamine formaldehyde resin and between approximately 50% and 15% respectively

of a cured melamine formaldehyde resin. The partially cured melamine formaldehyde composition includes between approximately 20% and 70% of cross-linked molecules. The partially cured melamine formaldehyde resin is prepared by heating an uncured melamine formaldehyde resin at a temperature of between 100°C and 140°C for between 2 hours and 3 hours. The cured melamine formaldehyde resin includes at least approximately 85% of cross-linked molecules.

In accordance with a third aspect of the present disclosure, there is disclosed a molded product made from a melamine formaldehyde molding composition that includes a partially cured melamine formaldehyde resin having between approximately 20% and 70% of cross-linked molecules and a cured melamine formaldehyde resin having at least approximately 85% of cross-linked molecules. The molded product has an improved microwave resistance of at least approximately 25%.

Brief Description of the Figures

FIG. 1 shows a flowchart of a process for manufacturing or preparing a melamine formaldehyde composition (or melamine formaldehyde molding composition or melamine molding compositions) according to particular embodiments of the present disclosure.

FIG. 2 shows the effects of microwave exposure on the quantity of formaldehyde released by molded products produced from the melamine formaldehyde molding composition of particular embodiments of the present disclosure

Detailed Description

Embodiments of the present disclosure relate to processes, methods, and/or techniques for manufacturing, preparing, or producing a melamine formaldehyde molding composition (also referred to as a melamine molding composition or a melamine formaldehyde resin or composition). The melamine formaldehyde molding composition includes a partially cured melamine formaldehyde resin and a cured or fully cured melamine formaldehyde resin. For purposes of the present disclosure, cured or fully cured melamine formaldehyde resin can be understood to be a melamine formaldehyde resin or composition that includes a proportion (or a percentage by weight) of cross-linked molecules or oligomers of at least approximately 85%, and more specifically at least

approximately 90%. In addition, partially cured melamine formaldehyde resin can be understood to be a melamine formaldehyde resin or composition that includes a proportion (or a percentage by weight) of cross-linked molecules of less than approximately 75%. More specifically, partially cured melamine formaldehyde resin can include between approximately 20% and 75%, for example between approximately 25% and 50%, of cross-linked molecules.

The cross-linking extent of the melamine formaldehyde resins can be easily determined by methods well known in the art. For the present invention, the crosslinking content was determined on the basis of a testing method for thermosetting plastics according to JIS K 6911.

Various embodiments of the present disclosure relate to particular, significant, and/or unexpected effects and/or advantages associated with selecting and/or varying the proportions of cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin of the melamine formaldehyde molding composition. When the proportion (or relative proportion) of cured or fully cured melamine formaldehyde resin of a molding composition (e.g., a melamine formaldehyde molding composition) is too high, the mold ability or workability of said molding composition (e.g., a melamine formaldehyde molding composition) is reduced or poor. Accordingly, the strength of molded products or articles made from molding compositions (e.g., melamine formaldehyde molding compositions) with an undesirably high proportion of cured or fully cured melamine formaldehyde is reduced or lowered. Alternatively, if the proportion of partially cured melamine formaldehyde of a molding composition (e.g., a melamine formaldehyde molding composition) is too high, there may be an increased likelihood or occurrence of cracking in molded products or articles produced from said molding composition (e.g., melamine formaldehyde molding composition)

In many embodiments of the present disclosure, the melamine formaldehyde molding composition includes between approximately 15% and 50% by weight of cured or fully cured melamine formaldehyde resin and between approximately 85% and 50% by weight of partially cured melamine formaldehyde resin. In various embodiments, the melamine formaldehyde molding composition includes between approximately 30% and 40% by weight of cured or fully cured melamine formaldehyde resin and between approximately 70% and 60% by weight of partially cured

melamine formaldehyde resin. For example, in specific embodiments, the melamine formaldehyde molding composition includes approximately 35% by weight of cured or fully cured melamine formaldehyde resin and approximately 65% of partially cured melamine formaldehyde resin. Cured or fully cured melamine formaldehyde resins can function as reinforcing agents for the melamine formaldehyde molding composition.

The melamine formaldehyde molding composition includes melamine and formaldehyde. Melamine is an organic base and a trimer of cyanamide. In addition, melamine has a 1,3,5-triazine skeleton. Formaldehyde is an organic compound with a formula of CH_2O. Formalin is a 37% aqueous solution of formaldehyde. In many embodiments of the present disclosure, the ratio of melamine to formaldehyde (or formalin) of the melamine formaldehyde molding composition is selectable and/or variable. The ratio of melamine to formaldehyde can be selected depending upon intended or target proportion of cross-linking between molecules of the melamine formaldehyde molding composition. The present disclosure teaches that the ratio of melamine to formaldehyde in the melamine formaldehyde molding composition can be selected and/or varied to enhance the hardness and/or durability (i.e., to reduce fragility) of molded products or articles made from the melamine formaldehyde molding composition. The ratio of melamine to formaldehyde in the melamine formaldehyde molding composition can also be selected and/or varied to increase resistance to microwave radiation or energy.

In addition, the present disclosure teaches selecting, varying, and/or balancing the relative quantity (e.g., relative percentage by weight) of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin in particular melamine formaldehyde molding compositions for achieving a desired, intended, or target set of properties and/or characteristics associated with said melamine formaldehyde molding compositions. The relative quantity (e.g., relative percentage by weight) of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin present in the melamine formaldehyde molding composition can also be selected and/or varied for producing molded products or articles (made from said melamine formaldehyde molding composition) with a desired, intended, or target set of properties. For instance, the relative quantity of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin in a particular melamine formaldehyde molding composition can be selected to

achieve increased hardness and/or thermal resistance of a resultant molded product made from said melamine formaldehyde molding composition. In addition, the relative quantity of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin in a particular melamine formaldehyde molding composition can be selected to achieve a desired (e.g., optimal) flow rate and/or workability of a resultant molded product made from said melamine formaldehyde molding composition.

Furthermore, the relative quantity of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin in a particular melamine formaldehyde molding composition can be selected to achieve an enhanced or increased resistance to microwave radiation or energy associated with a resultant molded product made from said melamine formaldehyde molding composition.

In several embodiments, the use of the melamine formaldehyde molding composition facilitates, enables, or allows manufacture or production of molded products or articles with significantly, surprisingly, and/or unexpectedly enhanced properties or characteristics, for instance significantly surprisingly, and/or unexpectedly increased resistance to microwave radiation, increased hardness, improved thermal resistance, and/or enhanced workability.

Aspects of Process Embodiments

The present disclosure provides processes, methods, and techniques for manufacturing, preparing, or producing the melamine formaldehyde molding composition (or melamine molding composition) of various embodiments of the present disclosure. The processes, methods, and techniques replace pulp-based reinforcing agents, which are currently commonly used in the manufacture of existing melamine formaldehyde molding compositions (or melamine molding compositions), with cured melamine formaldehyde resins for manufacturing or producing the melamine formaldehyde molding composition.

FIG. 1 is a flowchart of a process 100 for the manufacture, preparation, or production of a melamine formaldehyde molding composition according to particular embodiments of the present disclosure.

FIG.2 is a flowchart of FR Emission from 1 cycles microwave test.

A first process portion 110 involves preparing a cured or fully cured melamine formaldehyde resin. Therefore, the first process portion 110 includes curing a melamine formaldehyde resin (or melamine formaldehyde composition or compound).

Curing

In the field of polymer chemistry, the term curing generally refers to the toughening, hardening, or strengthening of a polymer material or resin by cross-linking polymer chains. Curing can be performed by using chemical additives, ultraviolet radiation, or heat. Typically, curing of a plastic or resin composition via a heating process causes the resin viscosity of the resin composition to fall initially upon application of heat. The resin velocity of the resin composition then passes through a region of maximum flow and then increases as the curing reactions increases the average length and degree of cross-linking between constituent molecules or oligomers of the resin composition. The curing process produces a continuous three-dimensional network of oligomer chains.

Upon completion of the curing process, the micro-structure of the cured resin composition is significantly fixed (i.e., there is very limited mobility for the constituent components, molecules, or elements of cured resin composition).Curing of melamine formaldehyde resin in the first process portion 110 occurs by heating a melamine formaldehyde resin (or melamine formaldehyde composition or compound), for instance in a hot air oven, at between approximately 160°C and 200°C for between approximately 3.5 hours and 4.5 hours. In several embodiments, melamine formaldehyde resin is heated at approximately 180°C for approximately 4 hours in order to cure the melamine formaldehyde resin. The melamine formaldehyde resin can be placed in a tray, for instance spread in a thin layer across the tray's surface during heating thereof. The thickness of the layer of melamine formaldehyde resin spread in the tray during the heating process can be between approximately 5mm and 15mm, and more specifically between approximately 6mm and 10mm. Spreading the melamine formaldehyde resin in a thin layer across the tray can facilitate or enable faster and/or better (e.g., more evenly distributed) heating of the melamine formaldehyde resin, and accordingly a more uniform curing process.

The cured melamine formaldehyde resin prepared or produced in the first process portion 110 has a proportion of cross-linked molecules of at least 85%. In many embodiments, the cured melamine

formaldehyde resin prepared or produced in the first process portion 110 has a proportion of cross-linked molecules of at least 90%. Accordingly, the cured melamine formaldehyde resin has a fixed, or substantially fixed, 3D structure or configuration.

In a second process portion 120, partially cured melamine formaldehyde resin is prepared. Partial curing of melamine formaldehyde resin can be achieved by heating melamine formaldehyde resin in a hot air oven at a temperature of between approximately 110°C and 130°C for between approximately 2 hours and 3 hours. For example, the melamine formaldehyde resin can be heated at approximately 120°C for approximately 2.5 hours to partially cure the melamine formaldehyde resin. The melamine formaldehyde resin can be placed or spread within a tray at a uniform, or substantially uniform, depth of between approximately 3nim and 9mm,and more specifically between approximately 4mm and 8mm, during the heating thereof.

In order to prepare or obtain partially cured melamine formaldehyde resin, the heating process (or heating of melamine formaldehyde) should be stopped or terminated upon or before the proportion of cross-linked molecules of the melamine formaldehyde resin reaches approximately 75%. In other words, in order to obtain partially cured melamine formaldehyde resins, the heating process (or the heating of melamine formaldehyde resin) should be stopped or terminated such that there remain at least approximately 25% of freely moving, mobile, or non cross-linked molecules in the melamine formaldehyde resin.

In several embodiments, the partially cured melamine formaldehyde resin includes between approximately 20% and 70% of cross-linked molecules. More specifically, in various embodiments, the partially cured melamine formaldehyde resin includes between approximately 30% and 50% of cross-linked molecules. The percentage of cross-linked molecules of the partially cured melamine formaldehyde resin (e.g., 30%-50% of cross-linked molecules) can facilitate or effectuate a significantly and/or unexpectedly enhanced flowability associated with the partially cured melamine formaldehyde resin. The flowability of the partially cured melamine formaldehyde resin can help to improve the ease or efficiency of compression process(es) for manufacture or production of molded products or articles (e.g., tableware and kitchen utensils).

In a third process portion 130, each of the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin produced by the first and second process portions 110, 120 respectively is preferably ground into small, or substantially small, particles using a grinding machine. The grinding machine used to grind (i.e., break down) the cured, or fully cured, melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be selected from existing grinding machines known in the particle sizing field.

In many embodiments, each of the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin is individually or separately ground. In several embodiments, each of the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be ground into different particle sizes. The cured or fully cured melamine formaldehyde resin can be ground to a particle size of between approximately 0.5mm and 2.0mm. In addition, the partially cured melamine formaldehyde resin can be ground to a particle size of between approximately 100μm and 1000μm. It will be understood that each of the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be ground to different sizes within the scope of the present disclosure. The size of each of the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be selected and/or varied as required, for instance to increase the strength of molded products made using the melamine formaldehyde molding composition and/or to enhance workability and/or moldability associated with the melamine formaldehyde molding composition.

Alternatively, the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be ground together or simultaneously in the grinding machine. In various embodiments, the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin can be simultaneously ground to a same particle size.

In a fourth process portion 140, the ground cured or fully cured melamine formaldehyde resin and the ground partially cured melamine formaldehyde resin are mixed or combined together in a predetermined, selected, or specific ratio and/or relative percentages by weight.

The ratio and/or relative percentage by weight of cured or fully cured melamine formaldehyde resin

to partially cured melamine formaldehyde resin can be selected, determined, and/or varied depending upon, or in order to achieve or provide, a desired, intended, or target set of properties and/or characteristics associated with the melamine formaldehyde molding composition. Additionally, or alternatively, the ratio and/or relative percentage by weight of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin can be selected, determined, and/or varied depending upon, or in order to achieve or provide, a desired, intended, or target set of properties and/or characteristics associated with the resultant molded product produce dusing said melamine formaldehyde molding composition.

In many embodiments of the present disclosure, the ratio of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin of the melamine formaldehyde molding composition is between 1 : 1 and 1 : 6. In several embodiments, the ratio of cured or fully cured melamine formaldehyde resin to partially cured melamine formaldehyde resin of the melamine formaldehyde molding composition is between 1 : 1.5 and 1 : 3.

The melamine formaldehyde molding composition can include between approximately 15% and 50% by weight of cured or fully cured melamine formaldehyde resin and between approximately 85% and 50% by weight correspondingly of partially cured melamine formaldehyde resin. More specifically, the melamine formaldehyde molding composition can include between approximately 30% and 40% by weight of cured or fully cured melamine formaldehyde resin and between approximately 70% and 60% by weight correspondingly of partially cured melamine formaldehyde resin.

The ratio of melamine to formaldehyde of the melamine formaldehyde molding composition is selectable and/or variable depending upon intended or target set of properties associated with the melamine formaldehyde molding composition or molded product produced from the melamine formaldehyde molding composition. In some embodiments, the ratio of melamine to formaldehyde of melamine formaldehyde molding composition is between 1:1 and 1:6. In various embodiments, the ratio of melamine to formaldehyde of melamine formaldehyde molding composition is between1:1 and 1:3, and more specifically between 1:1.5 and 1:2.

The combination of the ground (or small particle) cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin can be mixed or blended together in a container, mixer, or reactor (e.g., a ball mill). This mixing of the ground (or small particle) cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin can occur over a duration of between 5 hours and 7 hours, for instance 6 hours.

In a fifth process portion 150, a curing agent and/or a lubricating agent are added to the mixture of ground (or small particle) cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin.

The curing agent can be benzoic acid. In various embodiments, between approximately 0.05% and 0.1% by weight of benzoic acid can be added to the mixture of ground cured melamine formaldehyde resin and partially cured melamine formaldehyde resin. Alternatively, the curing agent can be, or include, sulphuric acid, phthalic anhydride, p-toluene sulphonamic acid derivative, hydrochloric acid, and/or a like acidic curing agent. In some embodiments, the curing agent can include a combination of benzoic acid, sulphuric acid, phthalic anhydride, p-toluene sulphonamic acid derivative, hydrochloric acid, and/or a like acidic curing agent. In particular embodiments, the curing agent includes approximately 50% of benzoic acid and approximately 50% of phthalic anhydride. In other embodiments, the curing agent includes approximately 30% of p-toluene sulphonamic acid derivative and approximately 70% of benzoic acid.

In several embodiments, the lubricating agent is or includes a metal stearate, for example zinc stearate, zinc myristate, or aluminium stearate. The lubricating agent caninclude one or a combination of zinc stearate, zinc myristate, and aluminium stearate. For instance, the lubricating agent can include approximately 50% of zinc stearate and approximately 50% of aluminium stearate; or approximately 50% of zinc stearate and approximately 50% of zinc myristate. In various embodiments, between approximately1.0% and 3.0% by weight of the lubricating agent (e.g., zinc stearate) is added to the mixture of ground cured melamine formaldehyde resin and partially cured melamine formaldehyde resin.

The addition of the curing agent (e.g., benzoic acid) and/or the lubricating agent (e.g., zinc stearate) is optional. In addition, the quantity of each of the curing agent and the lubricating agent of a particular melamine formaldehyde molding composition can be selected and/or varied. In particular embodiments, the melamine formaldehyde molding composition includes approximately 1.2kg/ton of curing agent and approximately 2.5kg/ton of lubricating agent.

The fourth and fifth process portion 140 and 150 can be performed simultaneously. In several embodiments, the various components (e.g., the cured or fully cured melamine formaldehyde, the partially cured melamine formaldehyde, the curing agent, and the lubricating agent) are mixed together in a container or a mixer (e.g., the bill mill), for a pre-determined or specific duration (e.g., between approximately 5 hours and 7 hours). In a sixth process portion 160, a set of tests (or evaluation procedures or processes) is performed for determining end point of the process 100. More specifically, the set of tests facilitate or enable determination of a set of properties associated with the melamine formaldehyde molding resin to thereby determine when the melamine formaldehyde molding composition produced by the process 100 can be harvested, isolated, or retrieved from the mixer (e.g., the ball mill).

As described above, the process 100 produces the melamine formaldehyde curing composition of various embodiments of the present disclosure. The cured or fully cured melamine formaldehyde resin is mixed with the partially cured melamine formaldehyde resin to thereby result in production of the melamine formaldehyde molding composition. More specifically, a specific quantity of cured or fully cured melamine formaldehyde resin is mixed or combined with a specific quantity of partially cured melamine formaldehyde resin to produce the melamine formaldehyde molding composition. The cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin of the melamine formaldehyde molding composition will react with each other during production of molded products or articles from the melamine formaldehyde molding composition. More specifically, heat and pressure provided by a compression machine during the production of molded products causes reaction between the cured or fully cured melamine formaldehyde molding resin and the partially cured melamine formaldehyde molding resin. In several embodiments, there is a desired, intended, or target set of properties to be associated with the

produced melamine formaldehyde molding composition. Accordingly, a set of corresponding tests can be performed to ensure that the melamine formaldehyde molding composition produced by the process 100 has, displays, and/or exhibits said desired, intended, or target set of properties.

In many embodiments, disk flow and/or curing time of the melamine formaldehyde molding composition is measured. The process 100 can be stopped and/or terminated, and the produced melamine formaldehyde curing composition harvested and/or extracted, upon determination that the produced melamine formaldehyde curing composition has, displays, or exhibits a desired, intended, or target disk flow and/or curing time.

In several embodiments, the desired, intended, or target disk flow of the melamine formaldehyde molding composition is between approximately 80mm and 110mm. More specifically, in various embodiments, the target disk flow of the melamine formaldehyde molding composition is between approximately 85mm and 100mm. In addition, in some embodiments, the desired, intended, or target curing time associated with the melamine formaldehyde molding composition can be between approximately 2.5 minutes and 6 minutes, for instance between approximately 3 minutes and 5 minutes.

Upon determining that the melamine formaldehyde molding composition has the desired, intended, or target set of properties, the process 100 can be said to be completed, and the prepared or produced melamine formaldehyde molding composition is harvested or retrieved from the container or mixer (e.g., ball mill).

The process 100 of several embodiments is cost-effective, significantly simple, and safe. In addition, the curing (e.g., full or complete curing and partial curing) of melamine formaldehyde resins in each of the first and second process portions 110 and 120 can be performed and/or completed by heating, without a need for chemical facilitators (e.g., catalysts and/or stabilizers).

Process for manufacturing or producing molded articles or products from the melamine formaldehyde molding composition

The present disclosure also provides processes for manufacturing or producing molded articles or products (e.g., kitchen utensils, tableware, and ornaments) from melamine formaldehyde molding compositions provided by various embodiments of the present disclosure.

A compression machine can be used for manufacturing or producing molded products or articles from the melamine formaldehyde molding composition. The compression machine provides heat and pressure to the melamine formaldehyde molding composition, and to its constituent cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin, to thereby facilitate or effectuate molding, formation, or production of the molded product.

The molded products (also referred to as melamine molded products or resultant molded products) that are produced from particular melamine formaldehyde molding compositions of the present disclosure possess, exhibit, or display enhanced properties and/or characteristics as compared to existing molded products made from melamine formaldehyde resins or compositions. More specifically, in particular embodiments, the molded products posses, exhibit, or display significantly, surprisingly, and/or unexpectedly enhanced properties and/or characteristics as compared to existing molded products.

In many embodiments of the present disclosure, the molded products display enhanced or improved microwave resistance (i.e., enhanced resistance to the absorption of or exposure to microwave radiation or energy). The molded products made or produced from the melamine formaldehyde molding composition of various embodiments of the present disclosure can have an improved microwave resistance of at least approximately 20% as compared to existing molded products made from other melamine formaldehyde resins. In particular embodiments, the molded products made or produced from the melamine formaldehyde molding composition of various embodiments of the present disclosure can have an improved microwave resistance of at least approximately 30%,40%, or even 50% as compared to existing molded products made from other melamine formaldehyde resins.

Test For Evaluating Microwave Resistance

A test for evaluating or determining the microwave resistance of an item (e.g., a molded product or article) is detailed below. However, it will be understood that other tests, methods, or techniques for evaluating or determining the microwave resistance of a particular item (e.g., a molded product or article) can also be used in the context of the present disclosure.

A test for evaluating microwave resistance starts by putting or introducing an item (e.g., the molded product), into a microwave oven. The item (e.g., the molded product) can include, contain, or hold a volume of water. The microwave oven is then used to perform a round of microwave treatment. Each round of microwave treatment involves supplying approximately 1000 watts of microwave energy for approximately 2 minutes. The item (e.g., molded product) is then inspected, observed, or analysed (e.g., visually inspected) to detect any physical changes (e.g., discoloration or deformation) thereto, which denotes or reflects susceptibility, or a lack of resistance, to microwave energy.

The microwave treatment can then be repeated for a predetermined number of rounds or cycles. For example, approximately 250, 300, 400, 500, or even more cycles of microwave treatment can be performed for evaluating the microwave resistance of the item (e.g., molded product). After each round of microwave treatment, the item (e.g., molded product) is visually observed to detect any physical changes (e.g., discoloration and/or deformation) thereto. A lack of any physical changes (e.g., discoloration and/or deformation) means that the item (e.g., molded product) is microwave resistant. On the other hand, presence of physical change(s), for example discoloration and/or deformation denotes a lack, removal, and/or absence, of microwave resistance of the item (e.g., molded product).

In several embodiments of the present disclosure, the molded product produced from the melamine formaldehyde molding composition is resistant to (or displays resistance to) at least approximately 200 cycles or rounds of microwave treatment, each round of microwave treatment involving microwave exposure of 1000 watts for approximately 2minutes. In particular embodiments, the molded product produced from the melamine formaldehyde molding composition is resistant to (or displays resistance to) more than 300, 400, 500, or even more cycles of microwave treatment. Therefore, the molded

product produced from the melamine formaldehyde molding composition can display significant, surprising, and/or unexpected resistance to microwave radiation or energy.

The molded product made from various melamine formaldehyde molding compositions of the present disclosure also exhibit or display a reduced release of formaldehyde or formalin during exposure to microwave radiation or energy. In particular embodiments, the molded product made from various melamine formaldehyde molding compositions of the present disclosure exhibit significant and/or surprising reduction in formaldehyde release or emission during exposure to microwave radiation or energy.

Test for formaldehyde Emission or Release

There are several existing or known tests for formaldehyde emission or release that may be used to determine or measure formaldehyde emission or release of molded products made from the melamine formaldehyde molding composition of various embodiments of the present disclosure.

In a particular test for formalin emission, water is introduced into an item (e.g., the molded product) before the item (e.g., molded product) is placed in a microwave oven. A predetermined number of microwave treatment cycles are performed, each cycle involving exposure to microwave radiation or energy of approximately 1000 watts for approximately 2 minutes. The microwave treatment can be performed for 300, 400, 500, or more cycles. Amount of formaldehyde release after each microwave treatment cycle, and/or after all the microwave treatment cycles, can be measured.

In several embodiments of the present disclosure, the molded product made or constructed from the melamine formaldehyde molding composition releases formaldehyde at a low, or significantly low level or amount, during each cycle, more particularly at each cycle of 300, 400, 500, or more cycles, of microwave treatment. The level or amount of formaldehyde released from the molded product made from the melamine formaldehyde molding composition at each cycle, more particularly at each cycle of 300, 400, 500, or more cycles, of microwave treatment is less than, for example significantly and/or surprisingly less than, the level or amount of formaldehyde released from existing molded products made from existing melamine formaldehyde resins or compositions.

The level of formaldehyde release of a molded product (e.g., container) can reflect or indicate the amount of formaldehyde released into a test sample contained within the molded product (e.g., container). For example, the test sample can include water, 3% acetic acid, or oil. The unit of measurement of the level of formaldehyde release can be expressed as quantity of formaldehyde present per volume of test sample (i.e., mg/dm^3).

In several embodiments, the molded product made or constructed from the melamine formaldehyde molding composition exhibits formaldehyde release of less than approximately $5.0mg/dm^3$ upon each cycle of microwave treatment (i.e., each 2-minute exposure to 1000 watts of microwave energy). In various embodiments, the molded product made or constructed from the melamine formaldehyde molding composition exhibits formaldehyde release of less than approximately $2.5mg/dm^3$, for example between approximately 1.5 mg/dm^3 and 1.75 mg/dm^3, upon each cycle of microwave treatment.

In addition, the molded product of various embodiments also display increased or improved thermal resistance as compared to existing molded articles made of melamine formaldehyde. For instance, the molded product can have an improved thermal resistance of at least approximately 10%, and in specific embodiments an improved thermal resistance of at least approximately 25%, as compared to existing molded articles.

The melamine formaldehyde molding composition provided by various embodiments of the present disclosure can be used for manufacturing or producing various household items, tableware, kitchen utensils (e.g., bowls, cups, and cutlery), and/or ornaments.

A specific example of a method or process for manufacturing or preparing a particular melamine formaldehyde molding composition is provided by a particular embodiment of the present disclosure is described below. However, it will be understood that the scope of the present disclosure is not limited in any way by the example described below. The example provided is solely for aiding or enabling the reader to have a better understanding and/or appreciation of particular embodiments of the present disclosure.

Measurement of Crosslinking Content

Measuring the percentage of crosslinking content of the melamine formaldehyde resin was achieved by using a test method for thermosetting plastics according to JIS K 6911.

According to this Japanese Industrial Standard, 5 g of melamine formaldehyde sample were put on a metal panel maintained at a temperature of 150 ± 3°C, nearly at the center, using the metal cylinder so as the sample forms a cone, and within 15 seconds, pressform it under the load of 19.60 kN and a pressure time of 2 minutes. Then, the major and minor diameters of the glossy part of the formed circular disk are measured by the measuring instrument to the nearest 1 mm, and the average value of the measurement for the elongation (mm) of the sample was calculated.

The following table illustrates the relationship between discflow (mm) and percentage of crosslinking content.

Table 1 Illustration of the relationship between discflow (mm) and percentage of crosslinking content.

Condition	Discflow (mm)	crosslinking content (%)
Non crosslinked melamine formaldehyde (reference)	140	0
Partially cured melamine formaldehyde (reference)	40-110	71.4 -21.4
Fully cured melamine formaldehyde (reference)	0-20	85.70-100
Melamine formaldehyde heated at 140° C for 2.5 hours (in example One)	91.25	34.8
Melamine formaldehyde heated at 180°C for 5 hours (in example One)	13.66	90.2

EXAMPLE ONE

A process or method for manufacturing or preparing a melamine formaldehyde molding composition, the melamine formaldehyde molding composition useable for manufacturing or producing molded products or articles such as kitchen ware and other household items, is described in Example One. The process includes preparing a cured, or fully cured, melamine formaldehyde resin or composition and a partially cured melamine formaldehyde resin or composition. The cured, or fully cured, melamine formaldehyde resin is prepared by heating melamine formaldehyde resin at 180°C for 4 hours.

Heating of the melamine formaldehyde resin at 180°C for 4 hours results in cross-linking of molecules or oligomers of the melamine formaldehyde resin to thereby produce cured, or fully cured, melamine formaldehyde resin with a composition or proportion of cross-linked molecules or oligomers of at least 90%. The partially cured melamine formaldehyde resin is prepared by heating melamine formaldehyde resin at 120°C for 2.5 hours. This heating of melamine formaldehyde resin at 120°C for 2.5hours produces partially cured melamine formaldehyde resin including less than 70% of cross-linked molecules. The partially cured melamine formaldehyde resin includes free-moving or mobile molecules.

The cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin are ground into small particles. More specifically, the cured or fully cured melamine formaldehyde resin is individually or separately ground into small particles. The fully cured melamine formaldehyde resin is ground to between approximately 0.5mm and 2.0mm, more specifically approximately 1.2 mm and the 10 partially cured melamine formaldehyde resin is ground to between approximately 100 um and 1000 um, more specifically approximately 500 um.

The ground cured or fully cured melamine formaldehyde resin is then mixed with the ground partially cured melamine formaldehyde resin in a ball mill. More specifically, approximately 35% by weight of ground cured melamine formaldehyde resin is mixed with approximately 65% by weight of ground partially cured melamine formaldehyde resin in the ball mill.

Thereafter, a curing agent, for example benzoic acid, and a lubricating agent, for example zinc stearate, are added to the mix of cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin. The contents of the ball mill are then mixed together for approximately 6 hours. The temperature during mixing of cured or fully cured melamine formaldehyde resin and partially cured melamine formaldehyde resin should be maintained below 45° C.

The resultant melamine formaldehyde molding composition produced has a melamine Formaldehyde ratio of between 1:1.5 and 1:2, more specifically approximately 1:1.6.

The resultant melamine formaldehyde molding composition has a disk flow rate of between 85mm and 100mm and a curing time of between 180 seconds and 300 seconds. In addition, the resultant melamine formaldehyde molding composition has a good workability and is suitable for shaping or molding into different shapes, configurations, types, and/or forms of molded articles.

Molded articles or products can be made or produced from the melamine formaldehyde molding composition. Such molded articles or products have significantly good physical properties and pass the tests required under TIS1245 Thai Industry Standards for melamine formaldehyde compound (which complied with Japanese Industrial Standard: Testing Methods for Thermosetting Plastics). Various properties of molded articles or products made from the melamine formaldehyde molding composition are provided in Table 2 below.

Table 2 : Table of Properties of Molded Products Manufactured From Melamine Formaldehyde Molding Composition

Property	Unit	Industry Standard / Requirement	Molded Product Manufactured From Melamine Formaldehyde Molding Composition
Bonding Strength	N/mm2	≥ 78.5	80.7 – 92.4
Charpy Impact Strength	J/cm	≥ 0.196	0.214 – 0.480
Water absorption	% by weight	≤ 0.8%	0.1-0.6
Boiling water absorption	% by weight	≤ 1.0%	0.2-0.8
Specific density	-	1.45 – 1.55	1.46-1.52
Heat resistance	-	-	Pass
Acid resistance	-	-	Pass
Food contact test: Emission	Formaldehyde / Phoenol	Not Found / Not Found	Not Found
Presence of Heavy Metal	Lead	≤ 1 mg/dm^3	Not Found
Evaporation Residue	Water	≤ 30 mg/dm^3	2-15
	Normal heptane	≤ 30 mg/dm^3	3-20
	Acetic Acid	≤ 30 mg/dm^3	8-22

The Charpy Impact Strength of the molded product produced from the melamine formaldehyde molding composition can also be significantly higher, for instance at least approximately 50% higher and in particular embodiments even 100% higher, than the Charpy Impact Strength of existing

molded products. In several embodiments, the Charpy Impact Strength can be between 0.15 J/cm2 and 0.75 J/cm2, and more specifically between 0.214 J/cm2 and 0.480 J/cm2.

The molded products produced from the melamine formaldehyde molding composition of particular embodiments also display significantly and/or unforeseeable low amounts of water evaporation residue. The molded products produced from the melamine formaldehyde molding composition of particular embodiments can display water evaporation residue of less than approximately 20 mg/dm3, for instance between 2.0mg/dm and 15 mg/dm .

The molded products produced from the melamine formaldehyde molding composition of particular embodiments can also display significantly and/or unexpectedly low levels of normal heptane evaporation residue. In some embodiments, the normal heptane vaporation residue is less than approximately 20 mg/dm3, for instance between 2mg/dm3 and 20 mg/dm3. Furthermore, the molded products produced from the melamine formaldehyde molding composition of particular embodiments can also display significantly and/or unexpectedly low levels of normal of acetic acid evaporation residue. In various embodiments, the acetic acid evaporation residue is associated with the melamine formaldehyde molding composition is less than approximately 22mg/dm3, for instance between 8 mg/dm3 and 22 mg/dm3.

In addition, molded articles or products made or produced from the melamine formaldehyde molding composition of Example One is resistant to microwave radiation or exposure. For instance, the molded articles can be resistance to multiple cycles of microwave treatment, wherein each cycle of microwave treatment involves exposure to1000 watts of microwave energy for approximately 2 minutes.

Table 2 illustrates the effects of microwave radiation or exposure on molded products produced from particular melamine formaldehyde compositions of the present disclosure. More specifically, Table 2 shows a comparison between the effects of microwave radiation or exposure on molded products produced from particular melamine formaldehyde compositions of the present disclosure and the effects of microwave exposure on existing molded products.

For purposes of the present disclosure, existing molded products can be understood to include 68% to 75% of melamine formaldehyde resin, 25% to 30% of alpha cellulose or pulp fiber, 0.2% to 2% of

curing agent, 1% to 3% of lubricating agent, and 1% to 3% of pigments or colorants (depending upon the color of existing molded products)

Table 3: Effects of microwave exposure on molded products produced from the melamine formaldehyde molding compositionand existing molded products

Number of cycles of microwave treatment	Existing molded products	Molding products produced from particular melamine formaldehyde molding compositions of the present disclosure
1	Visible discoloration and deformation	No visible discoloration or deformation
10	Visible discoloration and deformation	No visible discoloration or deformation
100	Visible discoloration and deformation	No visible discoloration or deformation
500	Visible discoloration and deformation	No visible discoloration or deformation

As shown in Table 3, the molded products produced from the melamine formaldehyde molding composition does not display any visible discoloration or deformation, even after 500 cycles of microwave treatment. This is in contrast to existing molded products that exhibit visible discoloration and deformation upon one cycle of microwave treatment.

Accordingly, the Table 3 shows that the melamine formaldehyde molding composition of various embodiments of the present disclosure, and hence the molded products made therefrom, exhibits significant and unexpected resistance to microwave exposure.

Furthermore, molded articles or products made or produced from the melamine formaldehyde molding composition of Example One display or exhibit a low, or significantly low, level of formaldehyde release. FIG. 2 shows the effect of microwave energy on the quantity of formaldehyde released by the molded product produced from the melamine formaldehyde molding composition.

As shown in FIG. 2, the molded products produced from melamine formaldehyde molding

composition of particular embodiments displayed a significantly reduced amount of formaldehyde release as compared to existing molded products. The molded products made from the melamine formaldehyde molding composition released less than 5.0mg/dm^3, more specifically less than 2.5 mg/dm^3 of formaldehyde during one cycle of microwave treatment. For instance, as shown in FIG. 2, the molded products of present disclosure can release approximately 1.67mg/dm^3, of formaldehyde during one cycle of microwave treatment: In comparison, existing molded products released more than approximately 7.5mg/dm^3, more specifically more than approximately 10mg/dm^3 of formaldehyde during each cycle of microwave treatment. For instance, as shown in FIG. 2, the exiting molded products can release approximately 12.10 mg/dm^3 of formaldehyde during each cycle of microwave treatment.

Accordingly, the quantity of formaldehyde released by molded products made from the melamine formaldehyde molding composition can be at least approximately 75% lower than the quantity of formaldehyde released by existing molded products. In particular embodiments the quantity of formaldehyde released by molded products made from the melamine formaldehyde molding composition can be at least approximately 80%, or even at least 85%, lower than the quantity of formaldehyde released by existing molded products. The decrease in formaldehyde released by molded products of various embodiments as compared to existing molded products can be significant, unexpected, and/or unforeseeable.

Food Safety Data

Molded products produced from the melamine formaldehyde molding composition of particular embodiments of the present disclosure were tested or analysed in relation to food safety. The reference standard used for measuring or analysing the food safety of the molded products is the European Commission Directive 2002/72/EC and its amendments. Table 4 shows food safety data associated with the molded products of various embodiments of the present disclosure.

Table 4: Food safety data associated with molded products produced from the melamine formaldehyde molding composition

Test Condition (European Commission Directive 2002/72/EC)	Standard permissible limit of specific migration of formaldehyde	Specific migration of formaldehyde associated with the molded product
30-minute exposure to 100°C	15 mg/kg	2 mg/kg
2-hour exposure to 70°C	15 mg/kg	0.6 mg/kg
10-day exposure to 40°C	15 mg/kg	3 mg/kg

According to the European Commission Directive 2002/72/EC and its amendments, the permissible quantity of specific migration of formaldehyde after a 30-minute exposure of the molded product to a temperature of 100° C is 15mg/kg; the permissible quantity of specific migration of formaldehyde after a 2-hour exposure of the molded product to a temperature of 70°C is 15mg/kg; and the permissible quantity of specific migration of formaldehyde after a 10-day exposure of the molded product to a temperature of 40 °C is 15mg/kg. The molded product of various embodiments displayed permissible quantities of specific migration of formaldehyde. In other words, the molded product of various embodiments meets the reference standard for food safety as according to the European Commission Directive 2002/72/EC and its amendments. Accordingly, the molded product can be safely used for food handling purposes, for instance food preparation and food storage. The molded product can make safe contact with food items.

In several embodiments, the specific migration of formaldehyde associated with the molded product is significantly and unexpectedly lower than conventionally required or observed. The specific migration of formaldehyde associated with the molded product can be less than approximately 25%, and in particular embodiments less than approximately 50% (or even less than approximately 75%), of the permissible quantities of specific migration of formaldehyde set by the European Commission Directive 2002/72/EC and its amendments.

For instance, the specific migration of formaldehyde associated with the molded product upon a 30-minute exposure to 100°C can be less than approximately 5mg/kg, for example approximately

2mg/kg. In addition, the specific migration of formaldehyde associated with the molded product upon a 2-hour exposure to 70°C can be less than approximately 2mg/kg, for example approximately 0.6mg/kg. Furthermore, the specific migration of formaldehyde associated with the molded product upon a 10-day exposure to 40°C can be less than approximately 5mg/kg, for example approximately 3mg/kg. Embodiments of the present disclosure relate to methods, processes, or techniques for manufacturing, preparing, or producing melamine formaldehyde molding compositions. The process includes mixing cured, or fully cured, melamine formaldehyde resins with partially cured melamine formaldehyde resins. Cured, or fully cured, melamine formaldehyde resins include at least 85%, more specifically at least 90%, of cross-linked molecules. Partially cured melamine formaldehyde resins include between 20%and 70%, more specifically between 25% and 50%, of cross-linked molecules. Therefore, melamine and/or formaldehyde molecules and/or oligomers of partially cured melamine formaldehyde resins display at least some degree of mobility.

In many embodiments, the cured or fully cured melamine formaldehyde resins are prepared by heating at a temperature of between 160°C and 200°C, for example at 180°C, for between 4 hours and 6 hours, for example 5 hours. In addition, the partially cured melamine formaldehyde resins can be prepared by heating at a temperature of between 110°C and 130°C, for example 120°C,for between 2 hours and 3 hours, for example 2.5 hours.

The relative quantities (e.g., relative quantities by weight) of cured or fully cured melamine formaldehyde resins to partially cured melamine formaldehyde resins within the melamine formaldehyde molding composition can be selected and/or varied as desired, for instance depending upon intended and/or target properties (e.g., resistance to microwave radiation) associated with the melamine formaldehyde molding composition and molded products made therefrom. In several embodiments, the melamine formaldehyde molding composition includes between approximately 15% and 50% of cured, or fully cured, melamine formaldehyde resins and between approximately 85% and 50% respectively of partially cured melamine formaldehyde resins. The melamine formaldehyde molding composition can also include a curing agent (e.g., one or a combination of benzoic acid, phthalic anhydride, p-toluene sulphonamic acid derivative, and hydrochloric acid). In addition, the melamine formaldehyde molding composition can also include a lubricating agent (e.g., one or a combination of zinc stearate, zinc myristate, and aluminium stearate).

The melamine formaldehyde molding composition of various embodiments is associated with significantly, surprisingly, and/or unexpectedly enhanced properties, for example a significantly, surprisingly, and/or unexpectedly high resistance to microwave radiation or energy. In several embodiments, the melamine formaldehyde molding composition is associated with an at least 20%, and in particular embodiments an at least 30%, 40%, or even 50%, improved resistance to microwave radiation as compared to existing melamine formaldehyde molding compositions or melamine molding compositions. The melamine formaldehyde molding composition can exhibit resistance to multiple cycles of microwave treatment, each cycle involving a 2-minute exposure to 1000 watts of microwave energy. For instance, the melamine formaldehyde molding composition can exhibit resistance to at least 10, 100, 500, or more cycles of microwave treatment.

In some embodiments, the melamine formaldehyde molding composition facilitates or enables manufacture or production of molded products or articles of an intended or target set of properties, for instance of a higher microwave resistance, increase hardness and/or strength, increased or improved thermal resistance, and/or enhanced durability.

The molded products or articles made from the melamine formaldehyde molding composition can display significant and/or unexpected reduction in formaldehyde release during microwave exposure or treatment. For instance, the molded products or articles made from the melamine formaldehyde molding composition can release less than approximately 5.0 mg/dm^3 of formaldehyde during exposure to 1000 watts of microwave energy for 2 minutes. In certain embodiments, the molded products or articles made from the melamine formaldehyde molding composition can release less than approximately 2.5 mg/dm^3, for instance between 1.5 mg/dm3 and 1.8 mg/dm^3, of formaldehyde during each 2 minute exposure to 1000 watts of microwave energy.

Particular embodiments of the disclosure are described above for addressing at least one of the previously indicated issues or problems associated with existing melamine compositions, melamine molding compositions, melamine formaldehyde compositions, or melamine formaldehyde molding compositions. While properties, characteristics, uses, advantages, and alternatives associated with certain embodiments have been described within the context of those embodiments, other embodiments

may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the disclosure. It will be appreciated that several of the above-disclosed methods, processes, techniques, compositions, molded products, or alternatives thereof, may be desirably combined into other different methods, processes, techniques, compositions, molded products, or applications. The above-disclosed methods, processes, techniques, compositions, molded products, or alternatives thereof, as well as various presently unforeseen or unanticipated alternatives, modifications, variations or improvements thereto that may be subsequently made by one of ordinary skill in the art, are encompassed by the following claims.

Claims

1. A method for preparing a melamine formaldehyde molding composition comprising:

providing a cured melamine formaldehyde resin, the cured melamine formaldehyde resin comprising at least approximately 85% of cross-linked molecules; and

mixing a partially cured melamine formaldehyde resin with the cured melamine formaldehyde resin, the partially cured melamine formaldehyde resin is prepared by heating an uncured melamine formaldehyde resin to a temperature of between 100 °C and 140 °C, the partially cured melamine formaldehyde resin comprising between approximately 20% and 70% of cross-linked molecules,

wherein the prepared melamine formaldehyde molding composition comprises between approximately 15% and 50% by weight of the cured melamine formaldehyde resin and between approximately 85% and 50%respectively by weight of the partially cured melamine formaldehyde resin.

2. The method as in claim 1, wherein the cured melamine formaldehyde resin comprising at least approximately 90% of cross-linked molecules and the partially cured melamine formaldehyde resin comprises between approximately30% and 50% of cross-linked molecules.

3. The method as in claim 1, wherein the prepared melamine formaldehyde molding composition comprises between approximately 30% and 40% by weight of the cured melamine formaldehyde resin and between approximately 70% and 60% respectively by weight of the partially cured melamine formaldehyde resin.

4. The method as in claim 3, wherein the prepared melamine formaldehyde molding composition comprises approximately 35% by weight of the cured melamine formaldehyde resin and approximately 65% by weight of the partially cured melamine formaldehyde resin.

5. The method as in claim 1, wherein the cured melamine formaldehyde resin is prepared by heating a melamine formaldehyde resin at a temperature of between 170°C and 190°C for between 3 hours and 5 hours.

6. The method as in claim 5, wherein the cured melamine formaldehyde resin is prepared by heating a melamine formaldehyde resin at a temperature of approximately 180°C for approximately 5 hours.

7. The method as in claim 1, wherein the partially cured melamine formaldehyde resin is prepared by heating the uncured melamine formaldehyde resin at a temperature of approximately 120°C for approximately 2.5 hours.

8. The method as in claim 1, further comprising adding at least one of a curing agent and a lubricating agent to the mix of cured melamine formaldehyde resin and partially cured melamine formaldehyde resin.

9. The method as in claim 8, wherein the curing agent comprises at least one of benzoic acid, phthalic anhydride, p-toluene sulphonamic acid derivative, and hydrochloric acid.

10. The method as in claim 9, wherein the lubricating agent comprises at least one of zinc stearate, zinc myristate, and aluminium stearate.

11. A melamine formaldehyde molding composition obtained by a method according to any of claim 1-10

12. The melamine formaldehyde molding composition as in claim 11, wherein the partially cured melamine formaldehyde resin is prepared by heating an uncured melamine formaldehyde resin at a temperature of between 100°C and 140°C for between 2 hours and 3 hours

13. The melamine formaldehyde molding composition of claim 11, wherein the cured melamine formaldehyde resin comprises at least approximately 90% of cross-linked molecules.

14. The melamine formaldehyde molding composition of claim 11, wherein the partially cured melamine formaldehyde resin comprises between approximately 30% and 50% of cross-linked molecules.

15. The melamine formaldehyde molding composition of claim 11, wherein the melamine formaldehyde molding composition comprises between approximately 30% and 40% of the cured melamine formaldehyde resin and between approximately 70% and 30% respectively of the partially cured melamine formaldehyde resin.

16. The melamine formaldehyde molding composition of claim 15, wherein the melamine formaldehyde molding composition comprises approximately 35% of the cured melamine formaldehyde resin and approximately 65% of the partially cured melamine formaldehyde resin.

17. The melamine formaldehyde molding composition as in claim 11, wherein a ratio of melamine to formaldehyde of the melamine formaldehyde molding composition is between 1:1 and 1:6.

18. The melamine formaldehyde molding composition as in claim 17, wherein a ratio of melamine to formaldehyde of the melamine formaldehyde molding composition is between 1:1.5and 1:2.

19. The melamine formaldehyde molding composition of claim 11, further comprising at least one of a curing agent and a lubricating agent.

20. The melamine formaldehyde molding composition as in claim 19, wherein the curing agent comprises at least one of benzoic acid, phthalic anhydride, p-toluene sulphonamic acid derivative, and hydrochloric acid and the lubricating agent comprises at least one of zinc stearate, zinc myristate, and aluminium stearate.

21. The melamine formaldehyde molding composition as in claim 20, wherein the curing agent comprises one of a combination of approximately 50% benzoic acid and approximately 50% phthalic anhydride and a combination of approximately 30% p-tuluenesulphonamic acid and approximately 70% benzoic acid.

22. The melamine formaldehyde molding composition as in claim 20, wherein the lubricating agent comprises one of a combination of approximately 50% zinc stearate and approximately 50% aluminium stearate and a combination of approximately 50% zinc stearate and 50 % zinc myristate.

23. A molded product made form a melamine formaldehyde molding composition according to any of claims 11 to 22

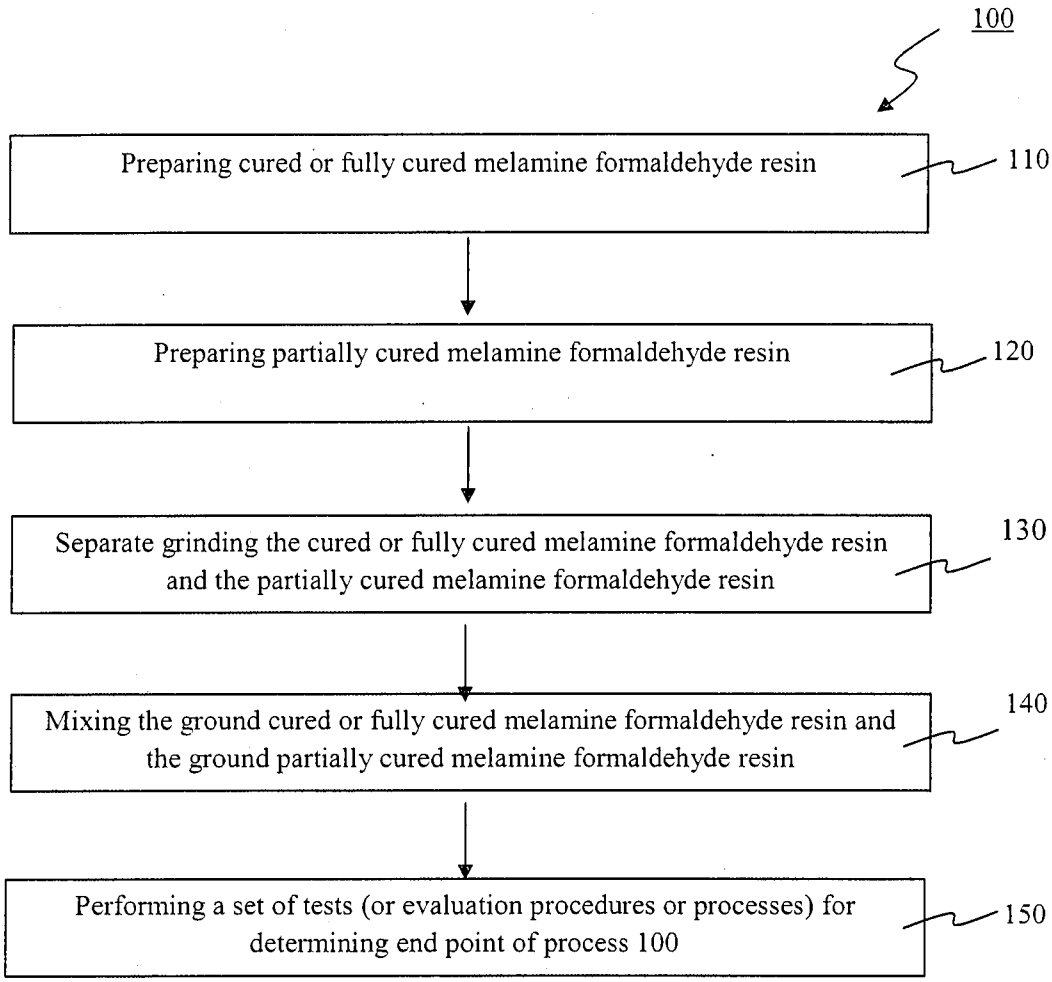
100
Preparing cured or fully cured melamine formaldehyde resin
110
Preparing partially cured melamine formaldehyde resin
120
Separate grinding the cured or fully cured melamine formaldehyde resin and the partially cured melamine formaldehyde resin
130
Mixing the ground cured or fully cured melamine formaldehyde resin and the ground partially cured melamine formaldehyde resin
140
Performing a set of tests (or evaluation procedures or processes) for determining end point of process 100
150

FIG. 1

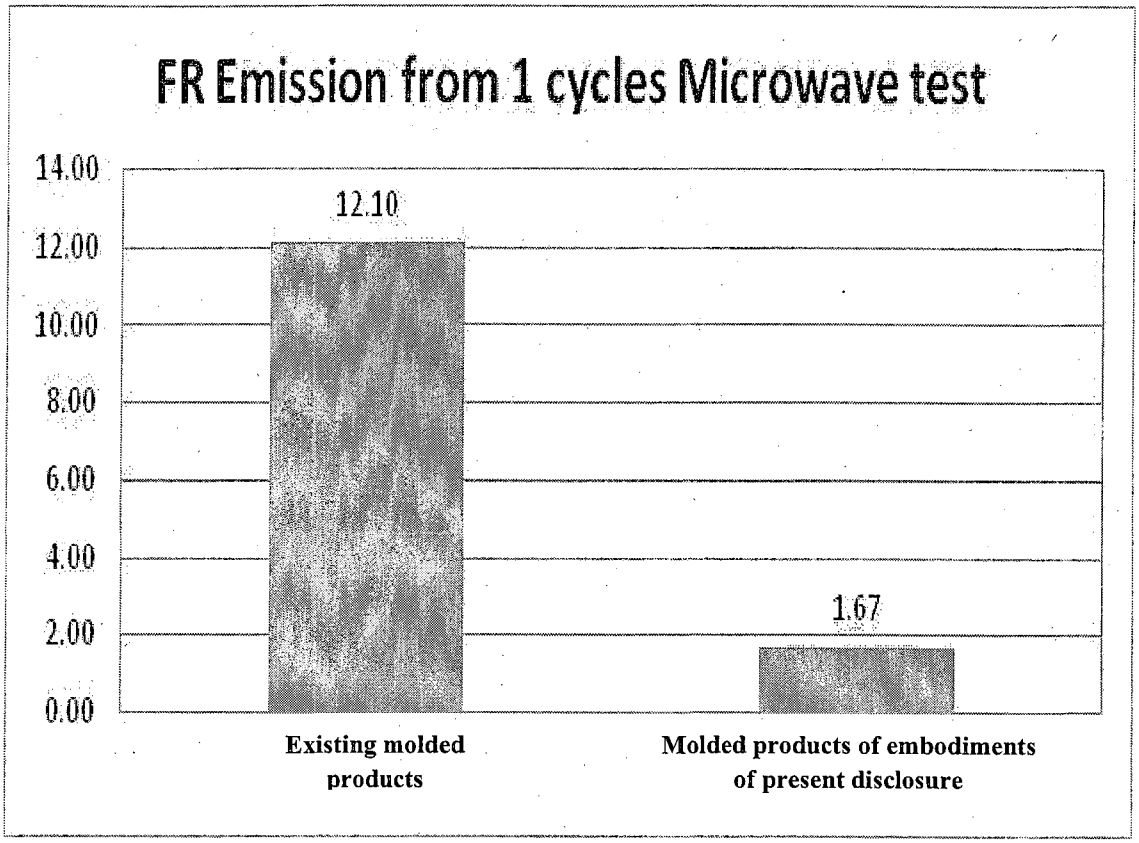
FR Emission from 1 cycles Microwave test
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
12.10
1.67
Existing molded products
Molded products of embodiments of present disclosure

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/TH2012/000007

A. CLASSIFICATION OF SUBJECT MATTER
INV. C08K7/00 C08L61/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C08K C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/111902 A1 (KORWIN-EDSON MICHELLE L [US] ET AL) 30 April 2009 (2009-04-30) claims 1-25; example 1 paragraph [0018] - paragraph [0043]	1-23
X	US 2006/079637 A1 (YUAN SAN C [US]) 13 April 2006 (2006-04-13) claims 1-18; examples 1-3 paragraph [0004] - paragraph [0013]	1-23
X	WO 2005/073266 A1 (AMI AGROLINZ MELAMINE INT GMBH [AT]; MACHHERNDL MARKUS [AT]; FUERST CH) 11 August 2005 (2005-08-11) claims 1-28; examples 1-18 page 4, line 2 - page 7, line 25	1-23

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2012	06/06/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Glomm, Bernhard

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/TH2012/000007

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/060001 A2 (CYTEC TECH CORP [US]) 24 July 2003 (2003-07-24) claims 1-19; examples 1-19 page 2, line 3 - line 7	1-23
X	WO 02/062885 A2 (CYTEC TECH CORP [US]; SASSI THOMAS PATRICK [US]) 15 August 2002 (2002-08-15) claims 1-13; examples 1-26 page 4, line 15 - page 9, line 26	1-23
X	EP 0 604 922 A1 (AMERICAN CYANAMID CO [US] CYTEC TECH CORP [US]) 6 July 1994 (1994-07-06) claims 1-22; examples 1-10 page 2, line 12 - page 3, line 2	1-23
X	DE 27 35 418 A1 (ARMSTRONG CORK CO) 9 February 1978 (1978-02-09) claims 1-25; examples 1-4 page 8, line 12 - page 10, line 6	1-23

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/TH2012/000007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009111902 A1	30-04-2009	NONE	
US 2006079637 A1	13-04-2006	EP 1799760 A1	27-06-2007
		US 2006079637 A1	13-04-2006
		WO 2006042299 A1	20-04-2006
WO 2005073266 A1	11-08-2005	AT 375371 T	15-10-2007
		CA 2554036 A1	11-08-2005
		CN 1914240 A	14-02-2007
		DE 102004006068 A1	18-08-2005
		EP 1720922 A1	15-11-2006
		ES 2296128 T3	16-04-2008
		US 2008227889 A1	18-09-2008
		WO 2005073266 A1	11-08-2005
WO 03060001 A2	24-07-2003	AT 299514 T	15-07-2005
		AU 2002348236 A1	24-07-2003
		AU 2002362127 A1	30-07-2003
		BR 0215217 A	16-11-2004
		CA 2470490 A1	24-07-2003
		CN 1608103 A	20-04-2005
		DE 60205041 D1	18-08-2005
		DE 60205041 T2	20-04-2006
		EP 1481024 A2	01-12-2004
		ES 2244832 T3	16-12-2005
		IL 162688 A	07-08-2008
		JP 2005514508 A	19-05-2005
		MX PA04006273 A	27-09-2004
		TW I228525 B	01-03-2005
		WO 03057772 A2	17-07-2003
		WO 03060001 A2	24-07-2003
		ZA 200404345 A	29-08-2005
WO 02062885 A2	15-08-2002	TW 555800 B	01-10-2003
		US 2002161075 A1	31-10-2002
		WO 02062885 A2	15-08-2002
		ZA 200302886 A	27-02-2004
EP 0604922 A1	06-07-1994	CA 2112415 A1	30-06-1994
		DE 69333697 D1	23-12-2004
		DE 69333697 T2	27-10-2005
		EP 0604922 A1	06-07-1994
		ES 2232810 T3	01-06-2005
		JP 6228305 A	16-08-1994
		US 5574103 A	12-11-1996
		US 5593735 A	14-01-1997
DE 2735418 A1	09-02-1978	DE 2735418 A1	09-02-1978
		JP 53021251 A	27-02-1978
		US 4128524 A	05-12-1978