



(11) **EP 2 058 368 B9**

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**

(15) Correction information:  
**Corrected version no 1 (W1 B1)**  
**Corrections, see**  
**Claims FR 1-11**

(51) Int Cl.:  
**C08L 67/04** <sup>(2006.01)</sup> **C08L 7/00** <sup>(2006.01)</sup>  
**B43L 19/00** <sup>(2006.01)</sup>

(48) Corrigendum issued on:  
**17.10.2012 Bulletin 2012/42**

(45) Date of publication and mention  
of the grant of the patent:  
**11.07.2012 Bulletin 2012/28**

(21) Application number: **08160521.4**

(22) Date of filing: **16.07.2008**

(54) **Eraser based on elastomer composition**

Löschvorrichtung aus Elastomerzusammensetzung

Gomme à effacer à base de composition élastomère

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT  
RO SE SI SK TR**

(30) Priority: **08.11.2007 JP 2007290488**

(43) Date of publication of application:  
**13.05.2009 Bulletin 2009/20**

(73) Proprietor: **Seed Company Ltd.**  
**Osaka 534-0013 (JP)**

(72) Inventors:  
• **Morimoto, Kazuki**  
**Osaka-shi Osaka 534-0013 (JP)**  
• **Nishioka, Yasuhiro**  
**Osaka-shi Osaka 534-0013 (JP)**

(74) Representative: **Vossius & Partner**  
**Siebertstrasse 4**  
**81675 München (DE)**

(56) References cited:  
**WO-A-2008/026632 US-A- 3 790 511**  
**US-A- 4 393 022 US-B1- 6 495 631**

- **HAN C C ET AL: "Melt reaction in blends of poly (3-hydroxybutyrate-co-3-hydroxyvalera te) and epoxidized natural rubber" POLYMER DEGRADATION AND STABILITY, BARKING, GB, vol. 85, no. 3, 1 September 2004 (2004-09-01), pages 947-955, XP004524162 ISSN: 0141-3910**
- **DATABASE WPI Week 200028 Thomson Scientific, London, GB; AN 2000-321811 XP002513594 & JP 2000 095898 A (NIPPON GOSEI GOMU KK) 4 April 2000 (2000-04-04)**
- **DATABASE WPI Week 199612 Thomson Scientific, London, GB; AN 1996-112818 XP002513595 & JP 08 012813 A (MITSUBISHI GAS CHEM CO INC) 16 January 1996 (1996-01-16)**

Remarks:

The file contains technical information submitted after the application was filed and not included in this specification

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 2 058 368 B9**

**Description**

**[0001]** The present invention relates to an eraser made of an elastomer composition, which can be recycled, is friendly to the environment, and corresponds to the recycling society, without relying on fossil resources.

**[0002]** So far, industries and economies have been advanced using fossil resources such as coal and petroleum oil and social systems based on mass production, mass consumption, and mass disposal have been established and many daily necessities have been based on the fossil resources whose depletion is now expected.

**[0003]** The present social systems have created economical affluence and convenience, but, on the other hand, wastes and carbon dioxide exceeding the natural purification capabilities have been discharged and it has resulted in serious environmental issues such as global warming and harmful substance generation.

**[0004]** In order to solve such problems, it is urgently required to reform today's one-way type social systems, in which a large quantity of commodities are produced from limited resources, consumed and disposed, and to shift the social systems to the recycling society, in which discharge of wastes can be suppressed and the limited resources can be advantageously utilized. To establish this recycling society, in our country, "Biomass Nippon Strategy" was decided upon by the Japanese government at a cabinet meeting held in December, 2002 and Japan has now been challenging reconstruction of the industrial competitive strength.

**[0005]** Biomass is sustainable and regenerable organic resources brought forth by natural blessings. Although biomass emits carbon dioxide when burned, carbon dioxide in atmospheric air is absorbed and fixed by photosynthesis at the time of plant growth and therefore biomass has a characteristic that it does not practically increase carbon dioxide. This is called "carbon neutral" and replacement of energy and commodities derived from fossil resources with biomass makes it possible to considerably lessen the carbon dioxide emission and accordingly, the techniques and product developments therefor have been acutely required.

**[0006]** In recent years, with respect to polymer materials as well, a plenty of proposals have been made in consideration of establishment of recycling society.

**[0007]** For instance, Japanese Patent Application Laid-Open (JP-A) No. 10-274494 describes a composition for rubber production containing natural rubber and biodegradable plastics (in Examples, a vulcanizing agent and a vulcanization accelerator are used). JP-A No. 2000-95898 describes a biodegradable material composition obtained by mixing a biodegradable material, epoxylated polyisoprene, and if necessary a crosslinking agent. JP-A No. 2000-319446 describes a biodegradable rubber composition obtained by adding a biodegradable resin and a filler to natural rubber. Further, JP-A No. 2003-183488 describes a polylactic acid type resin composition containing crystalline polylactic acid, and a rubber component selected from natural rubber and polyisoprene, and JP-A No. 2004-143315 describes a polymer blended material containing a continuous phase of polylactic acid and a dispersion phase of natural rubber or the like, evenly and finely dispersed in the continuous phase.

**[0008]** On the other hand, erasers can be broadly classified into three types: a vinyl chloride type eraser made of a vinyl chloride resin; a non-vinyl chloride type eraser made of a styrene type thermoplastic elastomer or an olefin type thermoplastic elastomer; and a natural rubber eraser.

**[0009]** Among them, more than 90 % of erasers in an eraser market are a vinyl chloride type eraser and a non-vinyl chloride type eraser. The polymer material, a plasticizer, and a softening agent composing the erasers are all materials derived from fossil resources such as petroleum oil and continuous use of these erasers is contradictory to the theme of the recycling society establishment.

**[0010]** On the other hand, for instance, as described in JP-A No. 2000-43492 and Gomu Kogyo Binran (Rubber Industry Handbook) (new edition, edited by The Society of Rubber Industry, Japan, published by The Society of Rubber Industry, Japan, Nov. 15, 1973, p. 817, Table 25.2), natural rubber erasers utilize biomass such as subs (factices) produced from natural rubber and plant oils and is in accord with the theme of the recycling society establishment.

**[0011]** US 3,790,511 discloses a gum eraser composed of a base rubber material and vulcanized rubber powder particles uniformly dispersed therein. US 4, 393, 022 describes an eraser based on PVC.

**[0012]** However, in the above-mentioned conventional techniques, those obtained without vulcanizing or crosslinking rubber are insufficient in tensile strength or elasticity and therefore applications thereof are sometimes limited and, for instance, they are inadequate as materials for erasers since they do not exhibit rubber elasticity. On the other hand, those which are vulcanized or crosslinked are also sometimes limited in applications because of excess tensile strength and elasticity and for instance, they become too hard as materials for erasers to give rubber elasticity and therefore inadequate. Further, since a vulcanizing or crosslinking step is necessary, the production process not only becomes complicated but also contains critical issue of safety of sulfur as a vulcanization agent and vulcanization chemical agents such as a vulcanization accelerator and an aid such as zinc oxide.

**[0013]** On the other hand, as described above, although the natural rubber erasers are suitable for satisfying the need for recycling society establishment, the natural rubber erasers are inferior in the erasing capability as compared with the vinyl chloride type erasers and since their production process includes a vulcanization step, the production process is complicated as compared with that for the vinyl chloride type erasers or non-vinyl chloride type erasers. Further, as

described above, there is an issue of safety of sulfur and vulcanization chemical agents such as a vulcanization accelerator. Moreover, reuse of wastes generated in the production process is difficult, so that it could result in uneconomical consequence and a problem in terms of productivity.

**[0014]** In view of the above state of the art, it is an object of the present invention to solve the above-mentioned problems of the conventional techniques and to provide an eraser made of an elastomer composition provided with physical properties such as tensile strength and elasticity, which have never been obtained by conventional vulcanization or crosslinking, containing a matrix of poly (3-hydroxybutyrate-co-3-hydroxyhexanoate) (hereinafter referred to as PHBH) and crosslinked natural rubber particles dispersed like islands in the matrix.

**[0015]** The present invention has accomplished the above-mentioned object and a first aspect of the present invention is

**[0016]** an eraser made of an elastomer composition containing a matrix of PHBH and crosslinked natural rubber particles dispersed like islands in the matrix.

**[0017]** A second aspect of the present invention is the eraser of the first aspect, in which the molar ratio of the repeating units of the PHBH, poly (3-hydroxybutyrate) / poly (3-hydroxyhexanoate) is not less than 80/20 and not more than 99/1 (mol/mol).

**[0018]** A third aspect of the present invention is the eraser of the first or second aspect, in which the elastomer composition is an eraser composition containing 50 to 99% by weight of natural rubber, 50 to 1% by weight of the PHBH, and 0.1 to 5 parts by weight of a rubber crosslinking agent to 100 parts by weight of the natural rubber.

**[0019]** A fourth aspect of the present invention is the eraser of any one of the first to third aspects, which further contains a softening agent.

**[0020]** A fifth aspect of the present invention is the eraser of the fourth aspect, in which the softening agent is derived from biomass.

**[0021]** A sixth aspect of the present invention is the eraser of the fourth or fifth aspect, in which the softening agent is selected from animal and plant oils and a plasticizer derived from these oils.

**[0022]** A seventh aspect of the present invention is the eraser of any one of the fourth to sixth aspects, in which an amount of the softening agent is 1 to 200 parts by weight to 100 parts by weight of the total of the natural rubber and the PHBH.

**[0023]** An eighth aspect of the present invention is the eraser of any one of the first to seventh aspects, which further contains a filler.

**[0024]** A ninth aspect of the present invention is the eraser of the eighth aspect, in which the filler is derived from biomass.

**[0025]** A tenth aspect of the present invention is the eraser of the eighth or ninth aspect, in which the filler is selected from a shell powder and an eggshell powder.

**[0026]** An eleventh aspect of the present invention is the eraser of any one of the eighth to tenth aspects, in which the amount of the filler is 10 to 1000 parts by weight to 100 parts by weight of the total of the natural rubber and the PHBH.

**[0027]** With respect to the elastomer compositions used for the eraser of the present invention, the materials to be used as raw materials not relying on the fossil resources are all natural rubber and PHBH which is a biodegradable polyester type plastic derived from biomass and accordingly, even if they are disposed, carbon dioxide in the atmospheric air is not increased and thus they are environmentally adequate elastomer compositions which are decomposed in natural environments.

**[0028]** Further, since the elastomer compositions used in the present invention are thermoplastic elastomers, the refuse generated at the time of molding can be easily recycled and accordingly, it leads to cost down and is thus adequate to the resource recycling society.

**[0029]** Further, in the elastomer composition production methods used in the present invention, since kneading of natural rubber and the PHBH and crosslinking of the natural rubber are simultaneously carried out, the process can be simplified and the productivity is high. Further, vulcanization agents and vulcanization accelerators such as sulfur and zinc oxide are not used for crosslinking the natural rubber, the safety is also high.

**[0030]** The elastomer compositions used in the present invention differ from materials obtained by the conventional vulcanization or crosslinking and are therefore suitable, for instance, for base materials of erasers.

**[0031]** The erasers of the present invention are friendly to the environment, being different from the conventional vinyl chloride erasers and non-vinyl chloride erasers which rely on fossil resources and the refuse generated at the time of molding is easily recycled and vain loss of materials is suppressed to result in cost down.

**[0032]** Further, with respect to the conventional natural rubber erasers, a crosslinking step is required in addition to a kneading step whereas kneading and crosslinking are carried out simultaneously in the present invention and the steps are simplified to increase the productivity.

**[0033]** Further, with respect to the conventional natural rubber erasers, vulcanization agents and vulcanization accelerators such as sulfur and zinc oxide are used whereas such chemical agents are not used for the erasers of the present invention and therefore the safety is high.

**[0034]** Moreover, the erasers of the present invention are provided with high erasing capability as compared with the conventional natural rubber erasers and non-vinyl chloride erasers.

**[0035]** Furthermore, the erasers made of the elastomer compositions containing the PHBH of the present invention are provided with higher erasing capability as compared with the erasers made of the elastomer compositions containing, for example, polylactic acid as a biodegradable plastic. This is presumably attributable to a melting point of 100 to 160°C of the PHBH which is lower than that of 170 to 180°C of the polylactic acid.

**[0036]** With respect to the erasing mechanism by an eraser, an eraser is closely contacted with letters written on a paper and rubbed against the letters. As a result, the letters are not only adsorbed on the eraser, but the surface of the eraser adsorbing letters is separated off from the eraser as erased scraps to renew the surface so as to be able to adsorb the letters again. Accordingly, it is considered that the erasing capability is greatly affected by proper abrasive performance caused by light stress such as human hands' force. The elastomer compositions used in the present invention comprise a discontinuous phase of rubber particles and a continuous phase of the PHBH and thus the abrasive performance is considered to be greatly influenced by physical properties of the continuous phase. In order to effect abrasion by light stress, the strength of the continuous phase should preferably be small. It is surmised that since the PHBH is lower in melting point than the polylactic acid, its strength is liable to decrease by the friction heat at the time of using an eraser, so that more suitable abrasive performance as an eraser can be provided.

**[0037]** The elastomer compositions used for the erasers of the present invention are characterized in that the compositions have a sea-island structure in which a matrix (sea) of the PHBH, crosslinked natural rubber particles are dispersed like islands in the matrix of the PHBH.

**[0038]** The natural rubber to be used in the present invention can be classified into sheet rubber, pale crepe, brown crepe, blanket crepe, block rubber, and crumb rubber, according to a method for processing the rubber from latex into solid type rubber, and various ranking grades are made available, and any natural rubber may be used regardless of production areas. Further, natural rubber derivatives, for example, epoxylated natural rubber, may also be used. They may be used alone or if necessary, two or more types may be used in combination.

**[0039]** The PHBH used in the present invention is, as described in JP-A No.2007-77232, produced from microorganisms and the molar ratio of the repeating units, i.e. poly (3-hydroxybutyrate) / poly (3-hydroxyhexanoate) is preferably not less than 80/20 and not more than 99/1 (mol/mol) from a viewpoint of the balance of flexibility and strength. By changing the composition ratio of the repeating unit, it is possible to change a melting point and a degree of crystallinity and further to change physical properties such as Young's modulus and heat resistance so that the physical properties ranging from polypropylene to polyethylene can be imparted.

**[0040]** The composition ratio of the natural rubber and the PHBH may be properly determined in accordance with applications and physical properties of the intended elastomer compositions, however, for base materials of erasers, the natural rubber is preferably in a range of 50 to 99% by weight and the PHBH in a range of 50 to 1% by weight; the natural rubber is more preferably in a range of 70 to 95% by weight and the PHBH in a range of 30 to 5% by weight. If the PHBH is less than 1% by weight, the fluidity of the elastomer compositions is worsened to cause a problem of moldability. If the PHBH exceeds 50% by weight, the elastomer compositions become too hard to exhibit rubber elasticity, and for instance, in the case of using them as base materials for erasers, it tends to become difficult to obtain a sufficient erasing capability.

**[0041]** The rubber crosslinking agents to be used preferably in the present invention may be organic peroxides. Practical examples are dicumyl peroxide (e.g. PERCUMYL® D, manufactured by NOF Corporation), 2,5-dimethyl-2,5-di-tert-butyl peroxyhexane (e.g. PERHEXA 25B, manufactured by NOF Corporation), di-tert-butylperoxydiisopropylbenzene (e.g. PERBUTYL P, manufactured by NOF Corporation), and 2,5-dimethyl-2,5-di-tert-butylperoxyhexyne-3 (e.g. PERHEXYNE® 25 B, manufactured by NOF Corporation). Additionally, other organic vulcanization agents may also be used. Practical examples are N,N'-m-phenylene dimaleimide (e.g. VULNOC PM, manufactured by Ouchi Shinko Chemical Industrial Co., Ltd.), p-quinonedioxime (e.g. VULNOC GM, manufactured by Ouchi Shinko Chemical Industrial Co., Ltd.), and alkylphenol-formaldehyde resin (e.g. TACKROL® 201, manufactured by Taoka Chemical Co., Ltd.). They may be used alone or if necessary, two or more kinds of them may be used in combination.

**[0042]** The rubber crosslinking agents may be used in an amount of 0.1 to 5.0 parts by weight to 100 parts by weight of natural rubber. If the amount of the rubber crosslinking agents is less than 0.1 part by weight, the crosslinking becomes insufficient and the natural rubber does not become particles, and therefore, it becomes impossible to obtain an intended structure and on the other hand, if the amount exceeds 5.0 parts by weight, the impact resilience of the crosslinked rubber particles tends to become so high to cause a problem of moldability.

**[0043]** The elastomer compositions used in the present invention may contain various kinds of additives to be used in fields of biodegradable plastic materials and natural rubber materials. Examples of such additives are ultraviolet absorbents, hindered amine type photo-stabilizers, weathering resistance improvers such as antioxidants, and lubricants of such as higher fatty acid alcohols, aliphatic amides, metal soaps, and fatty acid esters.

**[0044]** In the case where the elastomer compositions are used as base materials for erasers, other additives such as a softening agent, a filler, an organic or inorganic pigment, a coloring material such as dyes, a fragrance, a stabilizer, an antioxidant, a UV absorbent, and an anti-mold agent may be arbitrarily added to give elastomer eraser compositions.

**[0045]** Examples of the softening agent may be mineral oils, animal and plant oils, and plasticizers derived from them.

**[0046]** Practical examples of the mineral oils are paraffin type process oil, naphthene type process oil, and aromatic type process oil. Practical examples of the animal and plant oils are rapeseed oil, castor oil, cotton seed oil, linseed oil, soy oil, sesame oil, corn oil, safflower oil, palm oil, coconut oil, peanut oil, Japan tallow, rosin, pine tar, and tall oil. Plasticizers derived from animal and plant oils may include glycerin fatty acid esters and practical examples may be glycerin diacetomonoaurate, glycerin triacetate, and glycerol diacetate. They may be used alone or if necessary two or more of them may be used in combination. In terms of availability of elastomer compositions with further improved environmental friendliness, animal and plant oils derived from biomass, which are regenerable resources, or plasticizers derived from them are more preferable to be used.

**[0047]** The addition amount of the softening agent is 1 to 200 parts by weight to 100 parts by weight of a mixture of the natural rubber and the PHBH. It is preferably 10 to 150 parts by weight. If the softening agent is less than 1 part by weight, the addition amount of the softening agent is insufficient and on the other hand, if it exceeds 200 parts by weight, it may possibly result in occurrence of bleeding.

**[0048]** Examples of the fillers may be heavy calcium carbonate, light calcium carbonate, silica, diatomaceous earth, magnesium oxide, titanium oxide, talc, sericite, quartz powder, montmorillonite, shell powder of scallop, oyster, and freshwater clam, eggshell powder, organic hollow particles, and inorganic hollow particles. They may be used alone or if necessary, two or more of them may be used in combination. In terms of availability of elastomer compositions with further improved environmental friendliness, shell powders of scallop and oyster and eggshell powder derived from biomass, which are generated in a large quantity as wastes, are more preferable to be used.

**[0049]** The addition amount of the filler is 10 to 1000 parts by weight to 100 parts by weight of a mixture of the natural rubber and the PHBH. It is preferably 50 to 500 parts by weight. If the filler is less than 10 parts by weight, the addition amount of the filler is insufficient and on the other hand, if it exceeds 1000 parts by weight, the composition may possibly become hard and no sufficient rubber elasticity can be exhibited, and in the case of using the composition as a base material for an eraser, it tends to become difficult to obtain sufficient erasing capability.

**[0050]** The elastomer compositions used in the present invention can be obtained by putting the PHBH, natural rubber, a rubber crosslinking agent, and if necessary, a softening agent, and a filler in a kneader and kneading them at a temperature not lower than the melting temperature of the PHBH and not lower than the crosslinking temperature of the rubber crosslinking agent.

**[0051]** The kneading is preferable to be carried out under high shearing condition. Examples of such a kneader as enabling kneading under high shearing condition may be a biaxial kneading extruder, a Bambury mixer, a pressurizing kneader, and a mixing roll and among them is preferably the biaxial kneading extruder.

**[0052]** The word "a temperature not lower than the melting temperature of the PHBH" preferably means a temperature higher than the melting temperature of the PHBH by 10 to 50°C and the word "a temperature not lower than the crosslinking temperature of the rubber crosslinking agent" preferably means a temperature higher than the crosslinking temperature of the rubber crosslinking agent by 5 to 20°C.

**[0053]** The elastomer compositions used in the present invention have excellent elasticity and cushioning property and are thus useful for cushioning materials for wrapping, heat insulators, sound insulators, sound absorbing materials, tatami mat beds, floor materials and wall materials and particularly useful for base materials for erasers.

**[0054]** A reason for that the elastomer compositions used in the present invention has such unique physical properties as compared with conventionally vulcanized or crosslinked compositions is supposedly attributed to that the rubber component is cut in the course of kneading.

**[0055]** The erasers of the present invention using the above-mentioned elastomer eraser compositions are obtained by molding the elastomer eraser compositions by press molding, injection molding, and extrusion molding or the like, and cutting molded products into prescribed sizes to give erasers of elastomers.

**[0056]** Hereinafter, the present invention will be explained in more detail with reference to Examples and Comparative Examples, however it is not intended that the present invention be limited to them.

**[0057]** Materials employed in the following Examples and Comparative Examples are shown in Table 1.

Table 1

Product name	Material name	Maker
RSS#1	natural rubber	Produced in Indonesia
PHBH	poly (3-hydroxybutyrate-co-3-hydroxyhexanoate) (melting temp.: 120°C)	Kaneka Corporation
LACEA®H-100	polylactic acid (melting temp.: 164°C)	Mitsui Chemicals, Inc.
RIKEMAL PL-004	glycerin diacetomonoaurate	Riken Vitamin Co., Ltd.

(continued)

Product name	Material name	Maker
SS#80	heavy calcium carbonate	Nitto Funka Kogyo K.K.
Scallop shell powder	scallop shell crushed powder	Nitto Funka Kogyo K.K.
UNICA	light calcium carbonate	KOMESHO SEKKAI KOGYO CO., LTD.
MULTI Z	composite chinese white	KOMESHO SEKKAI KOGYO CO., LTD.
PERHEXA®C-40	40% diluted product of 1,1-di (t-butylperoxy) cyclohexane (crosslinking temp.: 120~150°C)	NOF Corporation
PERCUMYL® D-40	40% diluted product of dicumyl peroxide (crosslinking temp.: 150~180°C)	NOF Corporation
ADEKASTAB LA-32	benzotriazole type ultraviolet absorbent	ADEKA CORPORATION
ADEKASTAB LA-77G	hindered amine type photo-stabilizer	ADEKA CORPORATION
White Sub No. 1	sulfur chloride factice	Tenma Factice Manufacturing Co., Ltd.
DIANA PROCESS OIL NP-24	naphthenic type process oil	Idemitsu Kosan Co., Ltd.
Sulfax 200S	sulfur powder	Tsurumi Chemical Industry Co., Ltd.
NOCCELER TT	thiuram type vulcanization accelerator	Ouchi Shinko Chemical Industrial Co., Ltd.
NOCCELER DM	thiazole type vulcanization accelerator	Ouchi Shinko Chemical Industrial Co., Ltd.
N OCCELER BG	guanidine type vulcanization accelerator	Ouchi Shinko Chemical Industrial Co., Ltd.
Zinc oxide	zinc oxide	Sakai Chemical Industry Co., Ltd.

## Examples 1 to 11

**[0058]** The natural rubber, softening agents, fillers and photo-stabilizers among the materials shown in Table 2 were previously kneaded by a pressurizing kneader and the rubber crosslinking agents were added using rolls to obtain kneaded rubber materials. The obtained kneaded rubber materials were cut into pellets with about 5 mm square. Next, using a biaxial extruder KZW-15TW-60 (completely intermeshed type in same directions, screw diameter 15 mm, L/D = 60) manufactured by Technovel Corporation, the kneaded rubber pellets and biodegradable plastic pellets were supplied at the mixing ratio as shown in Table 2 by respective quantitative supplying units and kneaded at a screw rotation speed of 400 rpm and at a cylinder temperature in a range of 110 to 155°C.

**[0059]** The obtained composition pellets were extrusion-molded into a square rod-like shape by a uniaxial extruder (cylinder temperature 100 to 120°C, and head temperature 130°C) and cut into elastomer erasers to obtain erasers having a size of 12 × 18 × 43mm.

**[0060]** As the properties of the erasers were evaluated hardness and erasing capability (erasing ratio). The results are shown in Table 2.

**[0061]** The hardness was measured using C type hardness meter (Type C hardness meter, manufactured by Kobunshi Keiki Co., Ltd.) according to JIS S 6050 Plastic Erasers.

**[0062]** The erasing ratio was measured by the following method.

(1) A test specimen was obtained by cutting each sample into a 5 mm-thick plate-like piece and finishing the part to be brought into contact with testing paper to be an arc shape with a radius of 6 mm.

(2) The test specimen was brought into contact with colored paper perpendicularly and at right angles to colored lines and while a weight to be 0.5 kg in total of the weight and the weight of a holder was put on the test specimen, the test specimen was reciprocated 4 times on the colored part at 150 ± 10 cm/min for erasing the colored part.

(3) The densities of the colored part and the erased part were measured by a densitometer (DENSITOMETER PDA 65, manufactured by Sakura Co.) on the basis of the density, which was set 0, of non-colored parts of the colored paper.

(4) The erasing ratio was calculated according to the following equation.

$$\text{Erasing ratio (\%)} = (1 - (\text{density of erased part} \div \text{density of colored part})) \times 100$$

Table 2

Composition		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Ex. 11
Natural rubber	RSS#1	100	100	100	100	100	100	100	100	100	100	100
Biodegradable plastic	PHBH	45	45	45	35	45	45	45	45	45	45	45
Softening agent	RIKEMAL PL-004	70	70	70	70	70	70	70	80	70	70	70
Filler	SS#80	200	200	200			200	200	200	200	150	100
	SS#30										50	100
	Scallop shell powder				200	200						
	UNICA						10			10	10	10
	MULTI Z							10				
Rubber agent	crosslinking PERHEXA C-40	1.0	1.5	2.0	2.0	2.0	2.0	2.0	1.5	2.0	2.0	2.0
photo-stabilizer	ADEKASTAB LA-32									1.0	1.0	1.0
	ADEKASTAB LA-77G									1.0		
Natural rubber: biodegradable plastic ratio		69:31	69:31	69:31	74:26	69:31	69:31	69:31	69:31	69:31	69:31	69:31
Properties	Hardness (Ctype)	79	82	84	78	85	84	85	81	84	84	83
	Erasing ratio (%)	94	94	94	93	94	95	95	94	95	95	95

#### Comparative Example 1

**[0063]** An eraser was obtained in the same manner as in Example 7, except that the PHBH was replaced with polylactic acid (LACE® H-100, trade name of Mitsui Chemicals, Inc.) and the properties were evaluated.

However, in order to correspond to the melting temperature (160 to 170°C) of polylactic acid, the rubber crosslinking agent was changed to PERCUMYL® D-40 and the cylinder temperature was set at a range of 125 to 190°C. The results are shown in Table 3.

Table 3

Composition		Comp. Ex. 1
Natural rubber	RSS#1	100
Biomass plastic	LACEA® H-100	45
Softening agent	PIKEMAL L-004	70

(continued)

Composition		Comp. Ex. 1
Filler	SS#80	200
	SS#30	
	Scallop shell powder	
	UNICA	
	MULTI Z	10
Rubber crosslinking agent	PERCUMYL® D-40	2.0
photo-stabilizer	ADEKASTAB LA-32	
	ADEKASTAB LA—77G	
Natural rubber: biomass plastic ratio		69:31
Properties	Hardness (Ctype)	91
	Erasing ratio (%)	88

## Comparative Example 2

**[0064]** Using the materials shown in Table 4, all of the addition materials were kneaded with natural rubber using two rolls to obtain a kneaded rubber material. The obtained kneaded rubber material was previously molded corresponding to the prescribed size of a metal mold and vulcanized and molded using a heat press at 130°C for 20 minutes. The obtained molded rubber product was cut into prescribed size to obtain a natural rubber eraser and the properties of the obtained eraser were evaluated. The results are shown in Table 4.

Table 4

Composition		Comp. Ex. 2
Natural rubber	RSS#1	100
Substitute	White sub No.1	300
Filler	SS#80	400
Softening agent	DIANA PROCESS OIL NP-24	150
Vulcanization agent	Sulfax 200S	4
Vulcanization accelerator	NOCCELER TT	1
	NOCCELER DM	0.5
	NOCCELER BG	0.5
Vulcanization aid	zinc oxide	5
Properties	Hardness (C type)	60
	Erasing ratio (%)	90

**[0065]** As described above, since the elastomer composition used in the present invention comprises a biodegradable PHBH and natural rubber as main components, it is an elastomer composition which does not depend on fossil resources and is recycled without increasing carbon dioxide in the atmospheric air even if being discarded and thus it is friendly to the environment and responds to recycling societies. By using the elastomer composition as a base material for an eraser according to the present invention, it is possible to provide an eraser not only excellent in erasing capability and safety, but friendly to environments since it can be decomposed in natural environments.



## Claims

1. An eraser made of an elastomer composition containing a matrix of poly (3-hydroxybutyrate-co-3-hydroxyhexanoate) (hereinafter referred to as PHBH) produced from microorganisms and crosslinked natural rubber particles dispersed like islands in the matrix.
2. The eraser of Claim 1, wherein the molar ratio of the repeating units of the PHBH, poly (3-hydroxybutyrate) / poly (3-hydroxyhexanoate) is not less than 80/20 and not more than 99/1 (mol/mol).
3. The eraser of Claims 1 or 2, wherein the elastomer composition is an eraser composition containing 50 to 99% by weight of natural rubber, 50 to 1% by weight of the PHBH, and 0.1 to 5 parts by weight of a rubber crosslinking agent to 100 parts by weight of the natural rubber.
4. The eraser of any one of Claims 1 to 3, wherein a softening agent is further contained.
5. The eraser of Claim 4, wherein the softening agent is derived from biomass.
6. The eraser of Claim 4 or 5, wherein the softening agent is selected from animal and plant oils and a plasticizer derived from these oils.
7. The eraser of any one of Claims 4 to 6, wherein the amount of the softening agent is 1 to 200 parts by weight to 100 parts by weight of the total of the natural rubber and the PHBH.
8. The eraser of any one of Claims 1 to 7, wherein a filler is further contained.
9. The eraser of Claim 8, wherein the filler is derived from biomass.
10. The eraser of Claim 8 or 9, wherein the filler is selected from a shell powder and an eggshell powder.
11. The eraser of any one of Claims 8 to 10, wherein the amount of the filler is 10 to 1000 parts by weight to 100 parts by weight of the total of the natural rubber and the PHBH.

## Patentansprüche

1. Eine Löschvorrichtung, hergestellt aus einer Elastomerzusammensetzung, enthaltend eine Matrix aus Poly (3-hydroxybutyrat-co-3-hydroxyhexanoat) (nachstehend als PHBH bezeichnet), hergestellt aus Mikroorganismen, und vernetzte Naturkautschukteilchen, die wie Inseln in der Matrix dispergiert sind.
2. Die Löschvorrichtung nach Anspruch 1, wobei das Molverhältnis der Wiederholungseinheiten des PHBH, Poly (3-hydroxybutyrat)/Poly (3-hydroxyhexanoat) nicht weniger als 80/20 und nicht mehr als 99/1 (Mol/Mol) beträgt.
3. Die Löschvorrichtung nach Anspruch 1 oder 2, wobei die Elastomerzusammensetzung eine Löschvorrichtungszusammensetzung ist, die 50 bis 99 Gew.-% Naturkautschuk, 50 bis 1 Gew.-% des PHBHs und 0,1 bis 5 Gewichtsteile eines Kautschukvernetzungsmittels, auf 100 Gewichtsteile des Naturkautschuks, enthält.
4. Die Löschvorrichtung nach einem der Ansprüche 1 bis 3, wobei ferner ein Erweichungsmittel enthalten ist.
5. Die Löschvorrichtung nach Anspruch 4, wobei das Erweichungsmittel von Biomasse abstammt.
6. Die Löschvorrichtung nach Anspruch 4 oder 5, wobei das Erweichungsmittel ausgewählt ist aus Tier- und Pflanzenölen und einem Weichmacher, der von diesen Ölen abstammt.
7. Die Löschvorrichtung nach einem der Ansprüche 4 bis 6, wobei die Menge des Erweichungsmittels 1 bis 200 Gewichtsteile, auf 100 Gewichtsteile der Gesamtmenge an Naturkautschuk und PHBH, beträgt.
8. Die Löschvorrichtung nach einem der Ansprüche 1 bis 7, wobei ferner ein Füllstoff enthalten ist.

9. Die Löschvorrichtung nach Anspruch 8, wobei der Füllstoff von Biomasse abstammt.
10. Die Löschvorrichtung nach Anspruch 8 oder 9, wobei der Füllstoff ausgewählt ist aus einem Muschelpulver und einem Eierschalpulver.
11. Die Löschvorrichtung nach einem der Ansprüche 8 bis 10, wobei die Menge des Füllstoffs 10 bis 1000 Gewichtsteile, auf 100 Gewichtsteile der Gesamtmenge an Naturkautschuk und PHBH, beträgt.

## Revendications

1. Gomme à effacer faite d'une composition élastomère contenant une matrice de poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (désigné par PHBH ci-après) produit à partir de microorganismes et des particules de caoutchouc naturel réticulé dispersées comme des îlots dans la matrice.
2. Gomme à effacer selon la revendication 1, dans laquelle le rapport molaire des unités répétitives du PHBH, poly(3-hydroxybutyrate)/poly(3-hydroxyhexanoate) n'est pas inférieur à 80/20 et pas supérieur à 99/1 (mol/mol).
3. Gomme à effacer selon la revendication 1 ou 2, dans laquelle la composition élastomère est une composition de gomme à effacer contenant 50 à 99% en poids de caoutchouc naturel, 50 à 1% en poids du PHBH, et 0,1 à 5 parties en poids d'un agent de réticulation du caoutchouc pour 100 parties en poids du caoutchouc naturel.
4. Gomme à effacer selon l'une quelconque des revendications 1 à 3, contenant en outre un agent adoucissant.
5. Gomme à effacer selon la revendication 4, dans laquelle l'agent adoucissant est dérivé de la biomasse.
6. Gomme à effacer selon la revendication 4 ou 5, dans laquelle l'agent adoucissant est choisi parmi les huiles animales et de plantes et un plastifiant dérivé de ces huiles.
7. Gomme à effacer selon l'une quelconque des revendications 4 à 6, dans laquelle la quantité d'agent adoucissant est de 1 à 200 parties en poids pour 100 parties en poids du total du caoutchouc naturel et du PHBH.
8. Gomme à effacer selon l'une quelconque des revendications 1 à 7, contenant en outre une charge.
9. Gomme à effacer selon la revendication 8, dans laquelle la charge est dérivée de la biomasse.
10. Gomme à effacer selon la revendication 8 ou 9, dans laquelle la charge est choisie parmi une poudre de coquillage et une poudre de coquille d'oeuf.
11. Gomme à effacer selon l'une quelconque des revendications 8 à 10, dans laquelle la quantité de charge est de 10 à 1000 parties en poids pour 100 parties en poids du total du caoutchouc naturel et du PHBH.

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description

- JP 10274494 A [0007]
- JP 2000095898 A [0007]
- JP 2000319446 A [0007]
- JP 2003183488 A [0007]
- JP 2004143315 A [0007]
- JP 2000043492 A [0010]
- US 3790511 A [0011]
- US 4393022 A [0011]
- JP 2007077232 A [0039]

### Non-patent literature cited in the description

- Gomu Kogyo Binran. The Society of Rubber Industry,  
15 November 1973, 817 [0010]