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(54) **ROLLER STRUCTURE AND METHOD FOR THE MANUFACTURE THEREOF**

WALZENKONSTRUKTION UND VERFAHREN ZUR DEREN HERSTELLUNG

STRUCTURE DE ROULEAU ET SON PROCEDE DE FABRICATION

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09, 31 October 1995 (1995-10-31) & JP 07 155624
A (NITTO CHEM IND CO LTD), 20 June 1995
(1995-06-20)

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EP 1 494 811 B9

Description

[0001] The present invention relates to rollers or cylinders used in the devices for the processing of materials or products as well as to the method for the manufacture thereof.

[0002] In the description which follows reference will be made to rollers used in so-called "clod-breaking" devices for crushing clods or aggregates, it being understood that this is not intended to limit the scope of the invention, but only provide an example.

[0003] Clod-breaking devices are at present used in the technology for the manufacture of conglomerates or agglomerates formed by a granulated stone material and a binder (either of the inorganic type, such as for example a cement binder, or organic type, such as a hardening synthetic resin). In this technology, it is required to control, downstream of the mixing machines, the size of the aggregates or "clods" in the mixture formed by the above-mentioned granulate and the binder, before the mixture is transferred to the forming station and in particular before it is introduced into the forming mould.

[0004] U. S. patent No. 5 174 823 describes and illustrates a device for controlling the nature of the agglomerations of mixtures of the aforementioned type, said controlling operation relating to both the particle size and to the homogeneous distribution of the stone granulates inside the mixture.

[0005] The device in question comprises two rollers arranged with their respective axes parallel and spaced in an adjustable manner so as to set the distance between the two adjacent cylindrical surfaces to the desired value for the maximum size of the clods or mixture aggregates in the final products.

[0006] Preferably the two rollers are made to rotate at varying peripheral speeds and for this purpose a separate drive system is envisaged for each roller.

[0007] The two rollers are normally made of steel and are subject to wear in particular in the case of particularly hard and/or abrasive products and materials (such as, for example, quartziferous aggregates); when the wear reaches given levels, processing must be stopped so as not to adversely affect the quality of the final products.

[0008] During the stop the steel rollers are removed from the device where they are used, ground and reassembled. Obviously, these operations are complex, costly and in particular of a duration such that they interrupt for a not insignificant amount of time the cycle for processing of the agglomerates of stone materials.

[0009] In an attempt to overcome this drawback it has been proposed to manufacture the rollers using a ceramic material instead of steel, but with a limited degree of success since ceramic materials have mechanical characteristics which are unsuitable for withstanding other types of stresses which are present during the above-mentioned processing.

[0010] It has also been suggested to chrome-plate the steel rollers in order to make their surface harder, but it

has been found that chrome-plating releases metal oxides and/or other pigmented substances which, when in contact with the mixture - in particular if this is light-coloured - may alter the chromatic properties thereof, this being a not insignificant drawback considering that the aesthetic appearance is of great importance in the final products obtained with the mixture in question. Moreover, this drawback is also encountered in the case of stainless steel rollers.

[0011] Finally another grinding roller made uniquely of quartz glass, thus with a non-porous surface, and secured to a metal shaft through a layer of organic resin is disclosed in JP-A-07 155 624.

[0012] It would be desirable, and in fact forms a first object of the present invention, to provide rollers which have a high wear resistance, are mechanically strong and do not release substances able to alter the aesthetic appearance of the materials undergoing processing.

[0013] Another object of the invention is to provide a method for manufacturing the rollers which can be easily implemented, using techniques which are well-known per se and without a major financial investment.

[0014] These and other objects of the invention are achieved with a roller or cylinder having a non-porous external surface for the processing of materials and products, in particular for crushing and controlling the particle size of the aggregates or clods, formed by a mixture of at least one granulated stone material of suitable hardness and at least one binder, the roller being characterized in that the said surface consists of a non-porous agglomerate formed by a hardenable mixture comprising a granulated stone material of suitable hardness and a hardening resin as a binder.

[0015] In the preferred embodiment of the roller or cylinder according to the present invention, said agglomerate forms the coating, having a suitable thickness, of a cylindrical core or nucleus of the roller, said core being made of a mechanically resistant material, such as steel for example.

[0016] The stone material forming said agglomerate is in the form of a granulate having a controlled particle size scale (normally ranging between 0.1 and 2.0 mm) and chosen from among stone materials having a high hardness factor and a light colour.

[0017] As regards the core or nucleus of the roller, it is hollow and is also preferably metallic and cylindrical, even though this must not be understood as being a limitation in consideration that the shape of the core is not important while the external surface of the agglomerate coating formed onto the core has to be of a perfectly cylindrical shape.

[0018] Quartziferous aggregates, which combine a light colour with a high hardness factor, are particularly preferred as stone materials forming the said granulate.

[0019] As regards the hardening resin forming the binder of said agglomerate, it is preferably an epoxy resin which can be hardened by means of reaction with a suitable hardener, even though other synthetic resins, such

as for example polyester resins, may also be used.

[0020] In order to favour gripping of the coating of agglomerate to the core or nucleus of the roller or cylinder, the outer surface of the core or nucleus, i.e. that which is in contact with the agglomerate, is preferably roughened, for example by means of sandblasting. As an alternative and/or in addition, the outer surface of the core may be provided with grooves or ribs which improve the abovementioned gripping action.

[0021] Obviously the core of the roller is hollow so as to receive the components for mounting the said roller in the device used as well as the driving components.

[0022] In turn, the method according to the present invention is characterized in that the formation of the coating layer of agglomerate is performed after a casing or formwork has been prepared having an internal cavity with a shape and a size corresponding to the external shape of the roller to be manufactured.

[0023] More specifically the method for manufacturing rollers of the above defined type and having a non-porous external surface comprises the following steps:

- (a) preparation of a casing or formwork having an internal cavity with a shape and size corresponding to the external shape of the roller to be manufactured;
- (b) insertion, into said cavity, of a core so as to create an interspace having a thickness corresponding to the thickness of the roller to be manufactured;
- (c) filling of said interspace with a mixture able to constitute the said external surface,
- (d) extraction of the finished roller from said casing or form work,
- and characterized in that it also comprises the steps of :
- (e) compaction, if necessary, of the mixture contained in said interspace, the said mixture comprising a granulated stone material of a suitable hardness and a hardening resin as a binder;
- (f) hardening of the resin so as to obtain that the external surface of the roller consists of a non-porous agglomerate.

[0024] In order to improve the mechanical characteristics of the coating of agglomerate it is preferable to perform compaction of the mixture which fills the aforementioned interspace.

[0025] In the preferred embodiment of the method according to the present invention, this compaction is performed by arranging the casing or formwork, after filling with the aforementioned mixture, inside a chamber or bell in which an intense vacuum of predetermined value is established, while, at a first axial ends of the formwork, a pressing piston having an annular cross-section corresponding to the cross-sectional shape of the aforementioned interspace is operated at the same time so that its active surface acts exclusively on the surface of the mixture present in the said interspace. Obviously, at the second end of the formwork, a counter-plate must be pro-

vided in order to prevent the mixture, when subject to the action of the pressing piston, from coming out of this end.

[0026] At the same time a vibratory movement of predetermined frequency is applied to the pressing piston.

[0027] These combined and co-ordinated actions result in optimum compaction of the mixture which fills the interspace without porosity, especially on the surface, and with a homogeneous and uniform distribution of the resin, even though this is used in a minimum amount.

[0028] During the following step, hardening of the mixture present in the aforementioned interspace and then disassembly of the casing or external formwork are performed.

[0029] The resulting roller or cylinder is shown by way of example in the accompanying figure, where reference number 10 indicates the roller in general, while reference number 12 indicates the layer of agglomerate which surrounds the external surface of the core, which is preferably made of steel and designated by reference number 14. In case of rollers 10 for use in the clod-breaking devices, the outer diameter is of about 300 mm and the length of about 1.5 m.

[0030] As regards the coating of agglomerate 12, it preferably has a thickness of about 20-30 mm, while the steel core 14 has a thickness of about 15-20 mm.

[0031] The roller 10 has an outer surface of a high hardness so that it suffer a lower wear rate than the rollers made of conventional materials and does not release substances which may pollute, at least in terms of colouring, the material which is subject to the action of the roller.

[0032] It is worth noting that, in the already mentioned application in clod-breaking devices - where the conventional rollers periodically undergo cleaning of the remnants of mixture by means of a cleaning tool running along the surface of the roller at a distance of a few millimetres therefrom in the case of the rollers according to the present invention, it is possible to envisage providing the cleaning tool - which is subject to a translatory motion - with means adapted to perform, in addition to cleaning, also a slight grinding of the roller surface, thus restoring optimum operating conditions.

[0033] As already mentioned above, the present invention is applicable not only to the rollers used on clod-breaking devices, but also in all the other cases where it is required to perform the crushing of wearing materials and/or to avoid the release of substances which may pollute the material being processed by the rollers.

[0034] The invention has been described in relation to a preferred embodiment, it being understood that conceptually equivalent modifications and variations, as regards both the structure and applications, are possible and may be envisaged within the scope of protection of the following claims.

[0035] For example the rollers manufactured according to the present invention may be used in other applications where a high surface hardness and low or zero pollution of the material being processed are required.

[0036] It is equally possible to manufacture rollers formed entirely of agglomerate, in which case, according to the manufacturing method, the core arranged inside the cavity of the casing or formwork has a temporary function and is extracted from the roller once hardening of the agglomerate has been completed.

Claims

1. Roller or cylinder (10) having a non-porous external surface for the processing of materials and products, in particular for crushing clods or aggregates, formed by at least one granulated stone material and at least one binder, the roller (10) being **characterized in that** the said surface consists of a non-porous agglomerate (12) formed by a hardenable mixture comprising a granulated stone material of suitable hardness and hardening resin as a binder.
2. Roller or cylinder (10) for processing materials or products according to Claim 1, **characterized in that** said agglomerate (12) forms a layer coating a central core (14).
3. Roller or cylinder (10) for processing materials or products according to Claim 1, **characterized in that** the granulated stone material comprised in said mixture comprises quartziferous aggregates.
4. Roller or cylinder (10) for processing materials or products according to Claim 3, **characterized in that** the stone material comprised in said mixture is in form of granules of a particle size of between 0.1 and 2.0 mm.
5. Roller or cylinder (10) for processing materials and products according to Claim 1, **characterized in that** the hardening resin comprised in said mixture is epoxy resin.
6. Roller or cylinder (10) for processing materials and products according to Claim 1, **characterized in that** said the hardening resin comprised in said mixture is a polyester resin.
7. Roller or cylinder (10) for processing materials and products according to Claim 2, **characterized in that** said core (14) is made of steel and its surfaces in contact with said coating are roughened.
8. Roller or cylinder (10) for processing materials and products according to Claim 2, **characterized in that** the external surface of said core (14) is provided with grooves or ribbing for gripping.
9. Method for manufacturing rollers (10) having a non-porous external surface according to the preceding

claims, comprising the following steps:

- (a) preparation of a casing or formwork having an internal cavity with a shape and size corresponding to the external shape of the roller to be manufactured;
- (b) insertion, into said cavity, of a core (14) so as to create an interspace having a thickness corresponding to the thickness of the roller to be manufactured;
- (c) filling of said interspace with a mixture able to constitute the said external surface;
- (d) extraction of the finished roller from said casing or formwork, and **characterized in that** it also comprises the steps of :
 - (e) compaction, if necessary, of the mixture contained in said interspace, the said mixture comprising a granulated stone material of a suitable hardness and a hardening resin as a binder;
 - (f) hardening of the resin so as to obtain that the external surface of the roller consists of a non-porous agglomerate (12).

10. Method for manufacturing rollers (10) according to Claim 9, **characterised in that** the said compaction step (e) is performed by subjecting the mixture which fills the interspace to a pressing action combined with a vibratory movement.

11. Method for manufacturing rollers (10) according to Claim 9, **characterised in that** said compaction step (e) is performed under a vacuum.

12. Method for manufacturing rollers (10) according to Claim 9, **characterized in that** said compaction step (e) is performed by means of a pressing piston having a shaped annular head with a cross-section corresponding to that of said interspace of said formwork previously filled said mixture.

13. Method for manufacturing rollers (10) according to Claim 10, **characterized in that** said vibratory movement is applied to the said pressing piston.

Patentansprüche

1. Walze oder Zylinder (10) mit einer nicht-porösen äußeren Oberfläche zur Verarbeitung von Materialien und Produkten, insbesondere zum Zerstoßen von Klumpen oder Aggregaten, die aus mindestens einem granulierten Steinmaterial und mindestens einem Bindemittel gebildet sind, wobei die Walze (10) **dadurch gekennzeichnet ist, dass** die Oberfläche aus einem nicht-porösen Agglomerat (12) besteht, das aus einer härtbaren Mischung gebildet ist, die ein granuliertes Steinmaterial von geeigneter Härte

und ein Härteharz als ein Bindemittel aufweist.

2. Walze oder Zylinder (10) zur Verarbeitung von Materialien oder Produkten nach Anspruch 1, **dadurch gekennzeichnet, dass** das Agglomerat (12) eine Schicht bildet, die einen mittigen Kern (14) bedeckt. 5
3. Walze oder Zylinder (10) zur Verarbeitung von Materialien oder Produkten nach Anspruch 1, **dadurch gekennzeichnet, dass** das granuliertes Steinmaterial, das in der Mischung enthalten ist, quarzhaltige Aggregate aufweist. 10
4. Walze oder Zylinder (10) zur Verarbeitung von Materialien oder Produkten nach Anspruch 3, **dadurch gekennzeichnet, dass** das Steinmaterial, das in der Mischung enthalten ist, in Form von Körnchen mit einer Teilchengröße zwischen 0,1 und 2,0 mm vorliegt. 15
5. Walze oder Zylinder (10) zur Verarbeitung von Materialien und Produkten nach Anspruch 1, **dadurch gekennzeichnet, dass** das Härteharz, das in der Mischung enthalten ist, ein Epoxidharz ist. 20
6. Walze oder Zylinder (10) zur Verarbeitung von Materialien und Produkten nach Anspruch 1, **dadurch gekennzeichnet, dass** das Härteharz, das in der Mischung enthalten ist, ein Polyesterharz ist. 25
7. Walze oder Zylinder (10) zur Verarbeitung von Materialien und Produkten nach Anspruch 2, **dadurch gekennzeichnet, dass** der Kern (14) aus Stahl gefertigt ist und seine Oberflächen, die mit der Beschichtung in Kontakt stehen, aufgeraut sind. 30
8. Walze oder Zylinder (10) zur Verarbeitung von Materialien und Produkten nach Anspruch 2, **dadurch gekennzeichnet, dass** die äußere Oberfläche des Kerns (14) mit Nuten oder Rippungen zum Greifen versehen ist. 35
9. Verfahren zum Herstellen von Walzen (10) mit einer nicht-porösen äußeren Oberfläche nach den vorangehenden Ansprüchen, das die folgenden Schritte aufweist: 40
 - (a) Herstellen eines Gehäuses oder einer Verschalung, die einen inneren Hohlraum mit einer Form und Größe aufweist, die der äußeren Form der herzustellenden Walze entspricht; 50
 - (b) Einsetzen eines Kerns (14) in den Hohlraum, dergestalt, dass ein Zwischenraum geschaffen wird, der eine Dicke aufweist, die der Dicke der herzustellenden Walze entspricht; 55
 - (c) Ausfüllen des Zwischenraums mit einem Gemisch, das geeignet ist, die äußere Oberfläche zu bilden;

(d) Herausnehmen der fertiggestellten Walze aus dem Gehäuse oder der Verschalung; und **dadurch gekennzeichnet, dass** es ferner folgende Schritte umfasst:

(e) falls erforderlich, Verdichten der in dem Zwischenraum enthaltenen Mischung, wobei die Mischung ein granuliertes Steinmaterial von geeigneter Härte und ein Härteharz als ein Bindemittel aufweist,

(f) Härten des Harzes, um zu bewirken, dass die äußere Oberfläche der Walze aus einem nicht-porösen Agglomerat (12) besteht.

10. Verfahren zum Herstellen von Walzen (10) nach Anspruch 9, **dadurch gekennzeichnet, dass** der Verdichtungsschritt (e) in der Weise ausgeführt wird, dass die Mischung, die den Zwischenraum ausfüllt, einem Pressvorgang kombiniert mit einer Vibrationsbewegung unterzogen wird.

11. Verfahren zum Herstellen von Walzen (10) nach Anspruch 9, **dadurch gekennzeichnet, dass** der Verdichtungsschritt (e) unter Vakuum ausgeführt wird.

12. Verfahren zum Herstellen von Walzen (10) nach Anspruch 9, **dadurch gekennzeichnet, dass** der Verdichtungsschritt (e) mittels eines Presskolbens ausgeführt wird, der einen geformten ringförmigen Kopf mit einem Querschnitt aufweist, der dem des Zwischenraums der Verschalung entspricht, die zuvor mit der Mischung gefüllt wurde.

13. Verfahren zum Herstellen von Walzen (10) nach Anspruch 10, **dadurch gekennzeichnet, dass** die Vibrationsbewegung auf den Presskolben ausgeübt wird.

Revendications

1. Rouleau ou cylindre (10) ayant une surface externe non poreuse pour le traitement des matériaux et des produits, en particulier pour écraser des mottes ou des agrégats, formés par au moins un matériau en pierre granulé et au moins un liant, le rouleau (10) étant **caractérisé en ce que** ladite surface se compose d'un agglomérat non poreux (12) formé par un mélange durcissable comprenant un matériau en pierre granulé d'une dureté appropriée et une résine de durcissement comme liant.
2. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 1, **caractérisé en ce que** ledit agglomérat (12) forme une couche recouvrant un noyau central (14).
3. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 1, **caractérisé**

en ce que le matériau en pierre granulé compris dans ledit mélange comprend des agrégats quartzi-fères.

4. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 3, **caractérisé en ce que** le matériau en pierre compris dans ledit mélange est sous la forme de granules ayant une taille particulière entre 0,1 et 2,0 mm. 5
5. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 1, **caractérisé en ce que** la résine de durcissement comprise dans ledit mélange est une résine époxy. 10
6. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 1, **caractérisé en ce que** la résine de durcissement comprise dans ledit mélange est une résine polyester. 15
7. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 2, **caractérisé en ce que** ledit noyau (14) est fait en acier et ses surfaces en contact avec ledit revêtement sont rugueuses. 20
8. Rouleau ou cylindre (10) pour traiter des matériaux ou des produits selon la revendication 2, **caractérisé en ce que** la surface externe dudit noyau (14) est pourvue de rainures ou de nervures pour l'adhérence. 25
9. Procédé pour fabriquer des rouleaux (10) ayant une surface externe non poreuse selon les précédentes revendications, comprenant les étapes suivantes : 35
 - (a) la préparation d'un carter ou d'un coffrage ayant une cavité interne avec une forme et une taille correspondant à la forme externe du rouleau qui doit être fabriqué ; 40
 - (b) l'insertion, dans ladite cavité, d'un noyau (14) de sorte à créer un espace ayant une épaisseur correspondant à l'épaisseur du rouleau qui doit être fabriqué ;
 - (c) le remplissage dudit espace avec un mélange capable de constituer ladite surface externe ; 45
 - (d) l'extraction du rouleau fini dudit carter ou dudit coffrage, **et caractérisé en ce qu'il** comprend également les étapes de : 50
 - e) compactage, si nécessaire, du mélange contenu dans ledit espace, ledit mélange comprenant un matériau en pierre granulé d'une dureté appropriée et une résine de durcissement comme liant ; 55
 - f) durcissement de la résine de sorte à obtenir que la surface externe du rouleau se compose d'un agglomérat non poreux (12).

10. Procédé pour fabriquer des rouleaux (10) selon la revendication 9, **caractérisé en ce que** ladite étape de compactage (e) est effectuée en soumettant le mélange qui comble l'espace à une action de pressage combinée avec un mouvement vibratoire.

11. Procédé pour fabriquer des rouleaux (10) selon la revendication 9, **caractérisé en ce que** ladite étape de compactage (e) est effectuée sous vide.

12. Procédé pour fabriquer des rouleaux (10) selon la revendication 9, **caractérisé en ce que** ladite étape de compactage (e) est effectuée au moyen d'un piston de pressage ayant une tête de forme annulaire avec une coupe transversale correspondant à celle dudit espace dudit coffrage rempli auparavant dudit mélange.

13. Procédé pour fabriquer des rouleaux (10) selon la revendication 10, **caractérisé en ce que** ledit mouvement vibratoire est appliqué au dit piston de pressage.

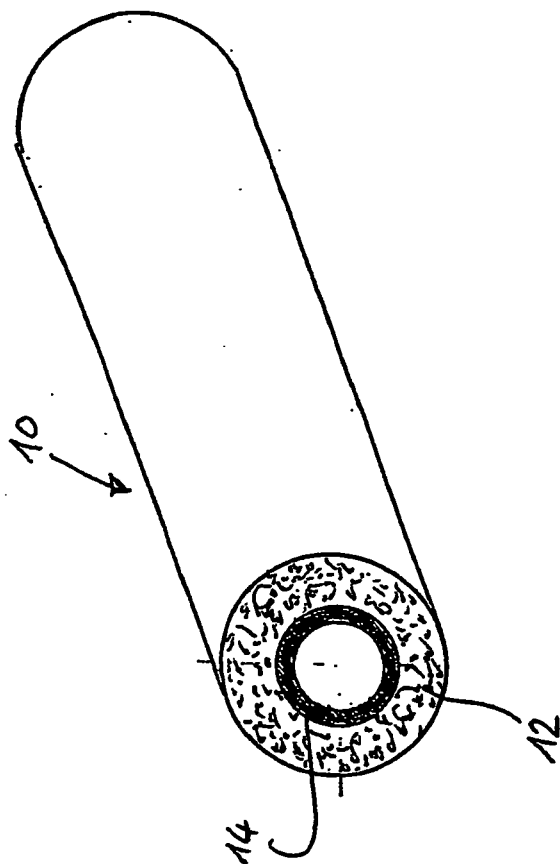


Fig 1

REFERENCES CITED IN THE DESCRIPTION

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