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74 Gemachtigde:

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54 **Method and system to convert demolished concrete into a readily recyclable product**

57 Method and system to convert demolished concrete into a readily recyclable product which is capable to reliably replace virgin feedstock that is used for manufacturing concrete, wherein converting the demolished concrete into the readily recyclable product comprises adding a plurality of information carriers to said product, wherein the plurality of information carriers are regularly distributed into said product by securing that each separate fraction of the product will hold a dedicated information carrier, and wherein each such dedicated information carrier is arranged to refer to information that is characteristic for the fraction of the product in which the dedicated information carrier is contained.

Method and system to convert demolished concrete into a readily recyclable product

5 The invention relates to a method to convert demolished concrete into a readily recyclable product which is capable to reliably replace virgin feedstock that is used for manufacturing concrete. The invention also relates to a system for implementing this method.

10 The dissertation by Kimberly Mary Cochran presented to the graduate school of the University of Florida in 2006 and entitled "CONSTRUCTION AND DEMOLITION DEBRIS RECYCLING: METHODS, MARKETS, AND POLICY" reports that concrete can be recycled into most markets that are currently satisfied by crushed stone. The most common markets for recycled concrete
15 are those in construction, specifically road base (86%), asphalt concrete (8%), and general fill (6%). If concrete is recycled, benefits are accrued through the reduction in need of virgin aggregates that the recycled aggregate is able to replace.

20 The replacement of virgin aggregates is however hampered because the industry is hesitant to replace primary by secondary raw materials. The industry perceives recycled material to be subject to a high variability in quality, and that there is a high cost associated in determining the usability
25 of a recycled product which is intended to replace virgin feedstock for the manufacture of concrete. If the quality of the recycled material is not up to standard, the reliability of the construction manufactured from concrete based on such recycled product is not guaranteed.

30 It is known from the article "Enhancing construction quality inspection and management using RFID technology", by Lung-Chuang Wang, Automation in Construction 17 (2008), pages 467 - 479 to provide plural RFID tags into a mixture of concrete from different construction sites. The RFID tags of this
35 article are intended to support a quality management system which functions as a platform for gathering, filtering, managing, monitoring and sharing quality data in order to enhance automated data collection and information management in a quality test lab.

It is an object of the invention to provide a method and system to convert demolished concrete into a readily recyclable real life product which is capable to reliably replace virgin feedstock that is used for manufacturing concrete, and to abolish the need to involve a test lab for situations that doubts would arise about the quality and suitability of the demolished concrete as a recycled product for replacement of virgin feedstock.

It is another object of the invention to provide real-time available information on the demolished concrete which characterizes said concrete on a high-resolution basis, meaning that the information will not so much relate to the demolished concrete in bulk, but will relate to the demolished concrete in fine enough fractions to support a reliable replacement of virgin feedstock by these fractions.

The method and system of the invention are for this purpose provided with the features of one or more of the appended claims.

In one aspect of the invention converting the demolished concrete into the readily recyclable product comprises adding a plurality of information carriers to said product immediately or shortly after demolishing the concrete, wherein the plurality of information carriers are regularly distributed into said product by securing that each separate fraction of the product will hold a dedicated information carrier, and wherein each such dedicated information carrier is arranged to refer to information that is characteristic for the fraction of the product in which the dedicated information carrier is contained. This increases the transparency of the recycled product and provides a reliable and easy way to access information defining such recycled product and the parties involved that handle the demolished concrete and the recycled product. The information can thus relate to quality, properties of the demolished concrete, manner of demolishing, original application and location of the demolished concrete, manner of transportation, owner of the original building, the concentration of information carriers in the product, etc. In particular, the information can help users of the product to design an optimal recipe for new concrete, including e.g. the amount of

cement, water, superplasticizer that is to be added to the recycled product, taking into account the quality of the recycled product and the intended application of the new concrete.

Suitably the dedicated information carriers are provided in the form of RFID tags. RFID tags are easily noticeable by cost-effective RFID readers and their presence can thus be established even if the tags are not visible and embedded in the recycled product.

It is found beneficial that each fraction of the product is provided to weigh approximately 1 ton. This provides a sufficiently dense distribution of information carriers in the recycled product to support a reliable characterization of this product as is, or as contained in a construction made from it, wherein unallowable deviations of the required specification of the recycled product can accurately be assessed.

It is further preferable that each information carrier is uniquely identified with an identifier such that the identifier of any such information carrier corresponds to an entry in a database, and wherein said entry holds the information that characterizes the fraction of the product in which the information carrier is contained. Access to the information then simply requires access to the database in which the information is contained.

It is further preferable that the information carrier has a size, material surface, and robustness that makes it compatible with the intended application in new concrete, e.g. by applying an outer shell made from a ceramic material and in a size that is within the range of the particle size of the recycled product.

To promote the benefits of the invention it is desirable that converting the demolished concrete into the readily recyclable product comprises analyzing properties of the demolished concrete and feeding the database with the established properties.

A desirable aspect of the invention is further that analyzing the properties of the demolished concrete is done in line and based on real time measurements during conversion of the demolished concrete into the readily recyclable product.

This brings about a tremendous advantage over the prior art in which it is required to execute time-consuming testing procedures when doubts arise about the quality of recycled concrete. These prior arts testing procedures may take up to 30
5 days, whereas the invention provides that the properties are monitored in real time and stored in the database to be immediately accessible for the user in the intended application. This saves costs of transporting and storing batches of the product in separate piles in facilities away from the source
10 or final destination until the quality of the recycled product is established.

In a preferred embodiment of the method of the invention converting the demolished concrete into the readily recyclable product comprises crushing of the demolished concrete
15 into coarse and fine fractions.

It is further advantageous that analyzing the properties of the demolished concrete comprises monitoring a stream of concrete fractions by laser induced breakdown spectroscopy to derive the properties of these concrete fractions. Laser
20 induced breakdown spectroscopy to analyze concrete waste is known from the article "Single-shot LIBS spectral quality for waste particles in open air" by Han Xia and Maarten C.M. Bakker, *Technisches Messen* 2015; 82(12): 606-615. Laser induced breakdown spectroscopy is able to deliver many thousands
25 of chemometric point analyses to characterize the respective fractions of the demolished concrete to comprise at least one of the group comprising concentration of pollutants, chemical composition, dry binder/cement paste material.

It is preferred that the laser induced breakdown
30 spectroscopy provides the properties of the concrete fractions at a rate of approximately 30 - 100 analyses per second and that several thousands of these analyses are combined into an average/standard deviation that is used for documenting the analyzed fraction of the recycled product.

The invention is also embodied in a system for implementing the method according to the invention, which system
35 comprises a plurality of information carriers that are individualized by a unique identifier provided on each concerning information carrier, wherein the system further comprises a

database with a plurality of entries, each entry corresponding to one identifier of an information carrier intended to be embedded in a fraction of demolished concrete, and the system further comprising at least one laser induced breakdown spectroscopy facility that is connected to the database for feeding the database with information characteristic for respective fractions of demolished concrete, such that each entry in the database that is identified with an identifier of an information carrier is equipped to hold information regarding such fraction of demolished concrete that is identified with the information carrier that is embedded in said fraction of demolished concrete.

Preferably the database of the system is accessible by a trading platform for the demolished concrete that is according to the invention converted into a readily recyclable product. The trading platform can provide users access to the information in the database that characterizes the recycled product to enable such users to assess whether the product is usable for their intended purposes.

The invention will hereinafter be further elucidated with reference to the drawing of an exemplary embodiment of a system and method according to the invention that is not limiting as to the appended claims. In the drawing of figure 1 the method and system according to the invention are represented by a schematic representation.

With reference 1 the step of demolishing concrete is represented. Following this demolition step reference 2 relates to the step of crushing of the concrete into coarse and fine fractions.

Immediately or shortly after the demolition step 1, preferably after crushing in step 2, the properties of the respective fractions of the concrete are established in step 3. For this purpose preferably use is made of a laser induced breakdown spectroscopy device 9 which is connected to a database 8 that can receive from said device 9 the information pertaining to the fractions of the demolished and crushed concrete. This information preferably relates to concentration of pollutants, chemical composition, dry binder/cement paste material.

At the same time that the laser induced breakdown spectroscopy device 9 provides its information to the database 8 pertaining to the fraction of the concrete being measured, one of a plurality of information carriers 7 is being embedded in the fraction that just is being measured by the laser induced breakdown spectroscopy device 9. This information carrier 7 is uniquely identified with an identifier which is also provided in the database 8, such that the identifier of such information carrier 7 corresponds to a particular entry in the database 8. Accordingly said entry of the database 8 thus can correspond to the information that is being provided to the database 8 by the laser induced breakdown spectroscopy device 9. The fraction of the product in which the information carrier 7 is embedded is thus characterized by the information provided to the database 8, and this information can at all times be retrieved using this particular identifier that is provided on the information carrier 7 which is embedded in the recycled product. In the database 8 the identifier will thus specifically refer to information, such as quality, properties of the demolished concrete, manner of demolishing, original application and location of the demolished concrete, manner of transportation, owner of the original building etc, all pertaining to the fraction of the recycled product in which the information carrier 7 with the concerning identifier is embedded.

The figure further shows that the database 8 is accessible by a trading platform 10 for the demolished concrete.

The following table is an example of the parameters/properties that can be included in the database for any type of recycled product that has been examined.

Property	Measuring ability of system	Acceptable range	Measured value	Standards
Particle size distribution	—	—	X	EN 933-1
Particle shape -flakiness index	0-50%	< 35%	X	EN 933-3
Resistance to freezing and thawing	0-10%	<4	X	EN 1367-1
Resistance to fragmentation (Los Angeles abrasion test)	0-50%	20-40%	X	EN 1097-2
Particle density	0-5.1	2.1-2.4	X	EN 1097-6
Water absorption	0-15%	3.7%-8.7%	X	EN 1097-7
Content of fine particles 63 μm	0-10%	<1.5%	X	EN 933-1
Resistance to abrasion (Micro Deval)	0-50%	13%-20%	X	EN 1097-1
Floating material (wood, plastics, foam)	0-10%	<0.5%	X	EN 933-11
Chlorides content	0-1%	< 0.01%	X	EN 1744-5
Sulphates	0-10%	<0.8 %	X	EN 1744-1

Although the invention has been discussed in the foregoing with reference to an exemplary embodiment of the method and system of the invention, the invention is not restricted to this particular embodiment which can be varied in many ways without departing from the invention. The discussed exemplary embodiment shall therefore not be used to construe the appended claims strictly in accordance therewith. On the contrary the embodiment is merely intended to explain the wording of the appended claims without intent to limit the claims to this exemplary embodiment. The scope of protection of the invention shall therefore be construed in accordance with the appended claims only, wherein a possible ambiguity in the wording of the claims shall be resolved using this exemplary embodiment.

Aspects of the invention are itemized in the following section.

1. Method to convert demolished concrete into a readily recyclable product which is capable to reliably replace virgin feedstock that is used for manufacturing concrete, wherein a plurality of information carriers (7) is added (5) to said product, characterized in that the plurality of information carriers (7) are added immediately or shortly after demolishing the concrete, and the information carriers (7) are regularly distributed into said

product by securing that each separate fraction of the product will hold a dedicated information carrier (7), wherein each such dedicated information carrier is arranged to refer to information that is characteristic for the fraction of the product in which the dedicated information carrier is contained.

2. Method according to claim 1, characterized in that the dedicated information carriers are provided in the form of RFID tags.

3. Method according to claim 1 or 2, characterized in that each fraction of the product is provided to weigh approximately 1 ton.

4. Method according to any one of the previous claims 1 - 3, characterized in that each information carrier is uniquely identified with an identifier such that the identifier of such information carrier corresponds to an entry in a database (8), wherein said entry holds the information that characterizes the fraction of the product in which the information carrier (7) is contained.

5. Method according to claim 4, characterized in that converting the demolished concrete into the readily recyclable product comprises analyzing (3) properties of the demolished concrete and feeding the database (8) with the established properties.

6. Method according to claim 5, characterized in that analyzing (3) the properties of the demolished concrete is done in line and based on real time measurements during conversion of the demolished concrete into the readily recyclable product.

7. Method according to any one of claims 1 - 6, characterized in that converting the demolished concrete into the readily recyclable product comprises crushing (2) of the demolished concrete into coarse and fine fractions.

8. Method according to any one of claims 5 - 7, characterized in that analyzing (3) the properties of the demolished concrete comprises monitoring a stream of concrete fractions by laser induced breakdown spectroscopy to derive the properties of the concrete fractions.

9. Method according to claim 8, characterized in that said properties of the respective fractions of the demolished concrete comprise at least one of the group comprising concentration of pollutants, chemical composition, dry binder/cement paste material.
10. Method according to claim 8 or 9, characterized in that the laser induced breakdown spectroscopy provides the identifier properties of the concrete fractions at a rate of approximately 30 - 100 analysis per second.
11. System for implementing the method according to any one of claims 1 - 10, wherein the system comprises a plurality of information carriers (7), characterized in that the information carriers (7) are individualized by a unique identifier provided on a concerning information carrier (7), wherein the system further comprises a database (8) with a plurality of entries, each entry corresponding to one identifier of an information carrier (7), and the system further comprising a laser induced breakdown spectroscopy facility (9) that is connected to the database (8) for feeding the database with information characteristic for fractions of demolished concrete, such that each entry in the database (8) that is identified with an identifier of an information carrier (7) is equipped to hold information regarding such fraction of demolished concrete that is identified with said information carrier (7) that is provided in said fraction of demolished concrete.
12. System according to claim 11, characterized in that the database (8) is accessible by a trading platform (10) for the demolished concrete that is converted into a readily recyclable product.
13. System according to claim 11 or 12, characterized in that the information carriers (7) have an outer shell made from a ceramic material.

CONCLUSIES

1. Werkwijze voor het omzetten van afgebroken beton in een direct herinzetbaar product welke in staat is om betrouwbaar niet-verwerkte grondstoffen te vervangen welke gebruikt worden voor het vervaardigen van beton, waarbij een
5 meertal informatiedragers (7) toegevoegd (5) wordt aan genoemd product, **met het kenmerk dat** het meertal informatiedragers (7) onmiddellijk of kort na het afbreken van het beton wordt toegevoegd, en de informatiedragers (7) regelmatig verdeeld in
10 genoemd product worden aangebracht door zeker te stellen dat iedere aparte fractie van het product een daarop gerichte informatiedrager (7) houdt, waarbij ieder van dergelijke afgestemde informatiedragers is ingericht om te verwijzen naar informatie die kenmerkend is voor de fractie van het product waarin de afgestemde informatiedrager is opgenomen.

15 2. Werkwijze volgens conclusie 1, **met het kenmerk dat** de afgestemde informatiedragers voorzien zijn in de vorm van RFID tags.

3. Werkwijze volgens conclusie 1 of 2, **met het kenmerk dat** iedere fractie van het product voorzien is om ongeveer 1 ton te wegen.
20

4. Werkwijze volgens één der voorgaande conclusies 1 - 3, **met het kenmerk dat** iedere informatiedrager uniek geïdentificeerd is met een identificator zodanig dat de identificator van iedere informatiedrager correspondeert met een ingang
25 in een database (8), waarbij genoemde ingang de informatie houdt die kenmerkend is voor de fractie van het product waarin de informatiedrager (7) is opgenomen.

5. Werkwijze volgens conclusie 4, **met het kenmerk dat** het omzetten van het afgebroken beton in het direct inzetbare
30 product omvat het analyseren (3) van eigenschappen van het afgebroken beton en het voeden van de database (8) met de vastgestelde eigenschappen.

6. Werkwijze volgens conclusie 5, **met het kenmerk dat** het analyseren (3) van de eigenschappen van het afgebroken beton in de lijn plaatsvindt en gebaseerd is op realtime-
35 metingen tijdens het omzetten van het afgebroken beton in het direct inzetbare product.

7. Werkwijze volgens één der conclusies 1 - 6, **met het kenmerk dat** het omzetten van het afgebroken beton in het direct inzetbare product omvat het vermorzelen (2) van het afgebroken beton in grove en fijne fracties.

5 8. Werkwijze volgens één der conclusies 5 - 7, **met het kenmerk dat** het analyseren (3) van de eigenschappen van het afgebroken beton omvat het monitoren van een stroom van betonfracties met laser geïnduceerde uitsplitsingspectroscopie voor het bepalen van de eigenschappen van de betonfracties.

10 9. Werkwijze volgens conclusie 8, **met het kenmerk dat** genoemde eigenschappen van de respectievelijke fracties van het afgebroken beton omvat ten minste één uit de groep omvattende concentratie van verontreinigingen, chemische samenstelling, droge binder/cement pastamateriaal.

15 10. Werkwijze volgens conclusie 8 of 9, **met het kenmerk dat** de laser geïnduceerde uitsplitsingspectroscopie de eigenschappen van de betonfracties verschaft met een snelheid van ongeveer 30 - 100 analyses per seconde.

20 11. Systeem voor het uitvoeren van de werkwijze volgens één der conclusies 1 - 10, waarbij het systeem omvat een meertal informatiedragers (7), **met het kenmerk dat** de informatiedragers (7) geïndividualiseerd zijn met een unieke identificator voorzien op een desbetreffende informatiedrager (7), waarbij het systeem verder omvat een database (8) met een
25 meertal ingangen, waarbij iedere ingang correspondeert met één identificator van een informatiedrager (7), en het systeem verder omvat een laser geïnduceerde uitsplitsingspectroscopiefaciliteit (9) die verbonden is met de database (8) voor het
30 voeden van de database met informatie die kenmerkend is voor fracties van het afgebroken beton, zodanig dat iedere ingang in de database (8) die geïdentificeerd is met een identificator van een informatiedrager (7) uitgerust is om informatie te houden betreffende een dergelijke fractie van afgebroken beton die geïdentificeerd is met genoemde informatiedrager (7) die
35 voorzien is in genoemde fractie van afgebroken beton.

12. Systeem volgens conclusie 11, **met het kenmerk dat** de database (8) toegankelijk is voor een handelsplatform (10) voor het afgebroken beton dat omgezet is in een direct inzetbaar product.

13. Systeem volgens conclusie 11 of 12, **met het kenmerk dat** de informatiedragers (7) een buitenschaal bezitten gemaakt uit keramisch materiaal.

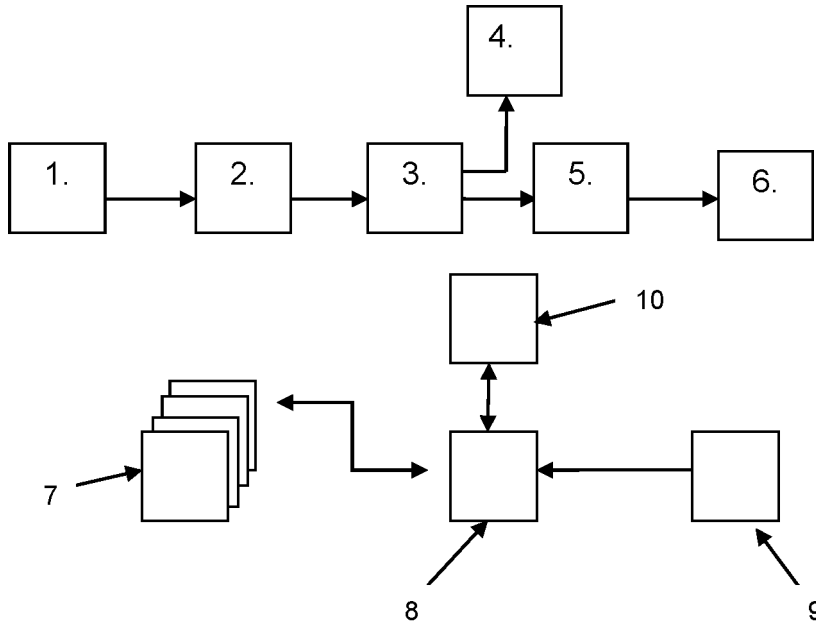


FIG. 1

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE 018243NL-PD
Nederlands aanvraag nr. 2021751	Indieningsdatum 03-10-2018
	Ingeroepen voorrangdatum
Aanvrager (Naam) Technische Universiteit Delft	
Datum van het verzoek voor een onderzoek van internationaal type 20-10-2018	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. SN72225
I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC) B09B3/00;B03B9/06;B09B5/00;C04B18/16;G06Q10/00;C04B28/00;C04B28/04	
II. ONDERZOCHE GEBIEDEN VAN DE TECHNIEK	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC	B09B;B04C;B03B;C04B;G06Q
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. <input type="checkbox"/>	GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES (opmerkingen op aanvullingsblad)
IV. <input type="checkbox"/>	GEBREK AAN EENHEID VAN UITVINDING (opmerkingen op aanvullingsblad)

**ONDERZOEKSRAPPORT BETREFFENDE HET
RESULTAAT VAN HET ONDERZOEK NAAR DE STAND
VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE**

Nummer van het verzoek om een onderzoek naar
de stand van de techniek

NL 2021751

A. CLASSIFICATIE VAN HET ONDERWERP		
INV.	B09B3/00 C04B28/00	B03B9/06 C04B28/04
	B09B5/00	C04B18/16
		G06Q10/00
ADD.		
Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.		
B. ONDERZOCHE TE GEBIEDEN VAN DE TECHNIEK		
Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)		
B09B B04C B03B C04B G06Q		
Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen		
Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)		
EPO-Internal, WPI Data		
C. VAN BELANG GEACHTE DOCUMENTEN		
Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 2011/000402 A1 (GRASSO JR LOUIS P [US]) 6 januari 2011 (2011-01-06)	1-10
Y	* alineas [0007] - [0016], [0027] - [0059] *	11-13
Y	----- DE 10 2015 122818 A1 (HYDRO ALUMINIUM ROLLED PROD [DE]) 29 juni 2017 (2017-06-29)	11-13
	* alineas [0001], [0002], [0007] - [0028], [0052] - [0070]; figuren *	
A	----- EP 2 482 241 A1 (NIKE INTERNATIONAL LTD [US]) 1 augustus 2012 (2012-08-01)	1-13
	* figuren *	
A	----- WO 2018/165669 A1 (GFSI GROUP LLC [US]) 13 september 2018 (2018-09-13)	1-13
	* figuren *	

<input type="checkbox"/> Verdere documenten worden vermeld in het vervolg van vak C. <input checked="" type="checkbox"/> Leden van dezelfde octrooifamilie zijn vermeld in een bijlage		
° Speciale categorieën van aangehaalde documenten		
"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft		"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding
"D" in de octrooiaanvraag vermeld		"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur
"E" eerdere octrooi(aanvraag), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven		"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht
"L" om andere redenen vermelde literatuur		"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie
"O" niet-schriftelijke stand van de techniek		
"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur		
Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type	
24 mei 2019		
Naam en adres van de instantie	De bevoegde ambtenaar	
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Tassinari, Francesca	

**ONDERZOEKSRAPPORT BETREFFENDE HET
RESULTAAT VAN HET ONDERZOEK NAAR DE STAND
VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE**

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar
de stand van de techniek

NL 2021751

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2011000402	A1	06-01-2011	GEEN

DE 102015122818	A1	29-06-2017	BR 112018010095 A2 13-11-2018
			CN 108463293 A 28-08-2018
			DE 102015122818 A1 29-06-2017
			EP 3393687 A1 31-10-2018
			JP 6454449 B1 16-01-2019
			JP 2019503850 A 14-02-2019
			KR 20180090892 A 13-08-2018
			US 2018297091 A1 18-10-2018
			WO 2017108908 A1 29-06-2017

EP 2482241	A1	01-08-2012	AU 2012200385 A1 16-08-2012
			CA 2765212 A1 03-04-2012
			CN 102646214 A 22-08-2012
			EP 2482241 A1 01-08-2012
			JP 2012160179 A 23-08-2012
			KR 20120088608 A 08-08-2012
			TW 201237797 A 16-09-2012
			US 2012197812 A1 02-08-2012

WO 2018165669	A1	13-09-2018	CN 109153150 A 04-01-2019
			EP 3397444 A1 07-11-2018
			US 2019066062 A1 28-02-2019
			WO 2018165669 A1 13-09-2018

WRITTEN OPINION

File No. SN72225	Filing date (<i>day/month/year</i>) 03.10.2018	Priority date (<i>day/month/year</i>)	Application No. NL2021751
International Patent Classification (IPC) INV. B09B3/00 B03B9/06 B09B5/00 C04B18/16 G06Q10/00 C04B28/00 C04B28/04			
Applicant Technische Universiteit Delft			

This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the application
- Box No. VIII Certain observations on the application

	Examiner Tassinari, Francesca
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WRITTEN OPINION**Box No. I Basis of this opinion**

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - a sequence listing
 - table(s) related to the sequence listing
 - b. format of material:
 - on paper
 - in electronic form
 - c. time of filing/furnishing:
 - contained in the application as filed.
 - filed together with the application in electronic form.
 - furnished subsequently for the purposes of search.
3. In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes: Claims	1-13
	No: Claims	
Inventive step	Yes: Claims	
	No: Claims	1-13
Industrial applicability	Yes: Claims	1-13
	No: Claims	
2. Citations and explanations
see separate sheet

WRITTEN OPINION

Application number

NL2021751

Box No. VII Certain defects in the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1 US 2011/000402 A1 (GRASSO JR LOUIS P [US]) 6 januari 2011 (2011-01-06)
- D2 DE 10 2015 122818 A1 (HYDRO ALUMINIUM ROLLED PROD [DE]) 29 juni 2017 (2017-06-29)

- 1 The present application does not meet the criteria of patentability, because the subject-matter of claim **1** is not new and claim **11** is not inventive.
- 2 Document **D1** (see figures and par. [0027]-[0037], [0046]-[0049]) discloses a method and a system for handling and tracking recyclable products such as post-consumer concrete (PCC). It describes their handling for reuse in an end product. In particular, it discloses (see par. 46-49 fig.2, 3 and 4a) tagging the PCC at the demolishing site for subsequent use with a plurality of information carriers (see fig. 4a) associated to the specific fraction of product.

The subject-matter of claim **1** is therefore not new.

- 3 Claim **11** essentially differs from document **D1**, which is considered to be the prior art closest to the subject-matter of claim **11**, in the following feature:

F1: *the system further comprising a laser induced breakdown spectroscopy facility connected to the database for feeding the database with information characteristic for fractions of demolished concrete.*

No unexpected technical effect seems to be associated with this distinguishing feature **F1**. The claim is not inventive because carrying out analysis of the fractions by laser induced breakdown spectroscopy is known in the available prior art, see for example in **Document D2**, belonging to the same technical field, par. 12-28 and 52-70.

Therefore in absence of unexpected effects combining the teaching of the two documents would be obvious to the person skilled in the art.

- 4 Dependent claims **2-10, 12** and **13** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step for the following reasons:
- 5 The subject-matter of dependent claims **2, 4** and **7** are not new over **D1** (see in D1 par. 36, 43-46 fig. 3 and 4a).
- 6 The subject-matter of dependent claims **3, 5, 6, 8-10** are not inventive since they refer to simple embodiments (claims 5, 6, 12) without providing an essential technical effect or they refer to results of simple optimization process (claims 3, 13) or they are suggested by the further cited documents (see eg. in **D2** par. 23 for cl. **8-10**).

Re Item VII

Certain defects in the application

- 7 The relevant background art disclosed in **D1** is not mentioned in the description, nor are these documents identified therein.