Abstract review of biodegradable hydrophobic materials

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Abstract: The most important fields of 3d printing technologies. The patent's examples. Keywords: 3d-printing, patents, civil engineering, industry, medicine.

Since Chuck Hull coined the term SLA in 1984 and created his first cup using 3D printing technology, the industry has grown phenomenally. The equipment has become more affordable — now you can order a 3D printer from the comfort of your home. The quality of printing has improved, its speed has increased, new methods and materials have appeared, and now this technology is being used in various fields.

The forecast data for the growth of the 3D printing market is more than encouraging:

1. In construction, the global market is expected to increase from $15 billion in 2023 to $34 billion in 2028.
2. The global industrial 3D printing market size is expected to grow from $3.83 billion in 2023 to $16.93 billion by 2030 at a CAGR of 23.6%.
3. In 2023, the global industrial additive manufacturing market reached approximately $13 billion. Between 2024 and 2032, the market is estimated to grow at a growth rate of 20.9%:
4. The global additive manufacturing market size was valued at USD 15 billion in 2022 and is expected to reach USD 95.62 billion by 2032, registering a growth rate of 20.4% during the forecast period from 2023 to 2032.
5. In 2021, the market volume of 3D printing technologies with polymers amounted to 4.6 billion US dollars. By 2030, this figure is likely to

exceed $34 billion at a growth rate of 24.8%. In 2022, metal 3D printing market revenues reached $2.85 billion, representing a 26% year-on-year growth. The expected figures for 2023 are $3.81 billion, and if growth continues at this pace, the market volume could reach $40 billion by 2032.

In the last months of 2024, new developments were made in the world. According to research and experience in various fields, this technology can reduce time and costs, as well as expand capabilities in any field.

In 3D software (e.g., AutoCAD, Revit, Inventor, Solid Works, or others), objects are modeled as 3D objects, then they are exported to other slicing software (e.g., determine the layer size – depending on the printing equipment, material, desired print resolution, etc.). A program file is then created for the entire object in the form of G-code that the printer can read and execute.

NEW 3D PRINTING TECHNOLOGIES IN CONSTRUCTION

Studies of the processes of effective construction of concrete structures of various functionality in construction are presented here. It is shown that reinforced concrete and the latest technological developments in its construction represent an interesting and important area of the current and future sphere of creating concrete structures of various functionality.

It should be noted that research is underway on the use of 3D construction for construction projects on the Moon.

Today, some of the conditions for the implementation of 3DP are known: The initial conditions are time and low labor requirements. It takes more time to achieve better surface quality, which increases the time spent. The second condition is the cost of optimization. Any optimization process will result in an increase in cost due to additional design work, and the structure can become unnecessarily complex.

All 3D printed materials must have exceptional print speeds. This includes feed and pumping capability, extrudability, layer adhesion, minimum primary curing time, and assembly.

As far as intellectual property is concerned, there are laws and regulations that protect new inventions and inventors. One area of future change will be the establishment of intellectual property protection principles for 3D models

To date, the main disadvantages are: the volume and inconvenience of using machines for 3D printing buildings, the problem with reinforcement, the difficulties of erecting a building to a height, technical problems in mountainous areas, the difficulties of printing horizontal elements (floors and roofs), exterior finishing work.

NEW 3D PRINTING TECHNOLOGIES IN INDUSTRY

A new report from the European Patent Office (EPO) confirms this observation.

In the last months of 2024, new developments were made in the world. According to the report, the U.S. and Europe are at the forefront of innovation in this area. Together, they account for nearly three-quarters of all 3D printing inventions in the world, with the U.S. leading the way with 40% and followed by Europe with 33%.

NEW 3D PRINTING TECHNOLOGIES IN MEDICINE

Additive manufacturing offers the medical industry greater design freedom, adaptability, and functional integration. For manufacturers of dentures, medical and prosthetic devices, orthoses and prostheses, this opens up many far-reaching opportunities. There is complete control over shapes, materials, and specific designs based on individual patient data, allowing for more personalized treatments, simplifying biomechanical reconstruction, and allowing for the rapid implementation of innovative therapies.

As a result, there are special products that are quickly available, which greatly improves the healing process and prognosis.

Following the news of the bioprinting industry, we found 4 new ideas/projects that promise great promise for the future. This is:

1. 3D-bioprinted designs that change shape over time
2. 3D-bioprinting based on microfluidics
3. A mini 3D printed heart that beats on its own
4. 3D Bioprinted Breast Implant

In each of these areas intensive research has been conducted and there are positive preliminary results. Below we give the examples novel patents.

WO2024238914 (A1) - COMPOSITION AND PRODUCTION METHOD FOR 3D PRINTING CONSTRUCTION MATERIAL

A composition of 3D printable photocurable material can include acrylate monomer(s) between about 0-30.0 composition wt%; acrylate oligomer(s) between about 0-30.0 composition wt%; photoinitiator(s) between about 0.02-1.0 composition wt%; chopped fiber(s) between about 0.1-3.0 composition wt%; flame retardant(s) between about 2.0-20.0 composition wt%; processing aid(s) between about 0.05-3.0 composition wt%; additive(s) between about composition 0-3.0 wt%; and filler(s) between about 20.0-80.0 composition wt%. The composition can have a viscosity of about 10,000-300,000 mPa·s, can be configured to be extruded at a printing speed of about 7-90 cm3/s during 3D printing, can be photopolymerized under UV or visible irradiation at a material depth of about 4-8 mm, and can be cured to form a building construction material.

WO2024237926 (A1) - 3D-PRINTED INTEGRATED WALL PANEL ASSEMBLY

A 3D-printed integrated panel, assembly, or other building element configured to form part of an overall building can include 3D-printed panels, connectors, and load transfer components. 3D-printed panels can be integrally formed by 3D printing technology using a photocurable composite material. A 3D-printed panel can include an outer frame shell defining a geometric shape having interior and exterior outer surfaces, side edges therebetween, and an infill structure therewithin, the infill structure forming internal cavities within the outer frame shell. Connectors can couple 3D-printed panels to each other and/or to separate building components of the overall building. Load transfer components can be coupled to and transfer loads across 3D-printed panels. Waterproofing elements can be coupled to 3D-printed panels, and thermal insulation material can be disposed within the internal cavities. The panel, assembly, or other building element can comply with building construction standards. Panels or assemblies can include wall panels.

US2024376710 (A1) - 3D-PRINTED INTEGRATED BUILDING PANEL SYSTEMS

A 3D-printed integrated building panel system configured to form a portion of an overall building can include 3D-printed building panels, connectors, and one or more load transfer components. Each 3D-printed building panel can be formed by 3D printing technology using a photocurable composite material, and at least a portion of the 3D-printed building panels can be integrally formed. The connectors can be coupled to one or more of the 3D-printed building panels and can couple the 3D-printed building panels to each other and/or to one or more separate building components of the overall building. The load transfer component(s) can be coupled to at least a portion of the 3D-printed building panels and can transfer loads across the 3D-printed building panels. The load transfer component(s) can be configured to form at least a portion of an overall super structure for the overall building.

US2024360668 (A1) - COMPOSITION AND METHOD FOR PRODUCTION OF A 3D PRINTED EARTH WALLS, NOZZLE AND MIXING SYSTEM FOR 3D PRINTING DEVICE PERFORMING SAID METHOD

A method for production of a 3D printed earth wall includes steps of:a) preparing a building composition (1), b) preparing a construction area (2), c) compacting the building composition (1), d) providing the building composition (1) in a form of an elastic rod (R) forming a first layer (L1) of the 3D printed earth wall (3) to the predetermined construction area (2) by a 3D earth wall printing device (4), e) repeating step d) for building further layers (L2 to LX) of the 3D printed earth wall (3) according to a specific construction design, f) curing the constructed printed earth wall (3), wherein the cross section of the rod (R) forming each layer of the building composition (1) is substantially rectangular. The nozzle for a 3D earth wall printing device comprises an inlet end (16) and a compacting end (17), wherein the compacting end (17) has a tapering shape which, together with the building composition (1) being supplied at an equivalent pressure (based on standard and modified Proctor tests), allows for a compaction of the building composition (1) during applying. The mixing system for a 3D earth wall printing device is configured to mix and homogenize the building composition (1) inside the mixing channel (20) using the mixing member (21), provide a homogeneous building composition (1) and to output the mixed homogeneous building composition (1) through the nozzle (15).

WO2024216295 (A2) - CONTINUOUS VAT POLYMERIZATION FOR THREE-DIMENSIONAL PRINTING

A system for constructing an article by 3D vat photopolymerization printing is disclosed comprising: a vat having a transparent bottom surface, wherein the vat is configured to hold a photopolymer resin; a building platform configured to elevate upwardly relative to the vat; an objective lens disposed below the transparent bottom surface of the vat; a radiation source disposed below the objective lens and configured to radiate through the objective lens to the vat for curing the photopolymer resin; and the system is configured to produce a continuously changing photomask image that is projected to the photopolymer resin in the vat as the building platform is elevated during 3D printing. The radiation source may comprise: an LCD photomask and a LED disposed. The objective lens and LCD photomask may be configured to move during a printing process as the building platform is moving.

US2024342953 (A1) - CONTROL OF A 3D PRINTER FOR THE ADDITIVE MANUFACTURING OF BUILDINGS

A computer-implemented method is employed for actuating a 3D printer for an additive manufacturing method, in particular filament printing, of structures of a building with concrete or other construction materials. The method may include reading in a 3D model via a CAD interface, in which model the structures are represented in an identifiable manner in structural data in a first design format, reading in printer parameters via a printer interface which parameters represent requirements and/or design specifications of the 3D printer and executing a structure conversion algorithm which uses the structural data represented in the first design format to calculate filament structural data in a second design format for a filament structure on the basis of the printer parameters which have been read in. Control instructions are calculated based on the calculated filament structural data, and the calculated control instructions are transmitted to the 3D printer for the purpose of control.

US2024326353 (A1) - A Dynamic Configurable Digital Mold

Described is a method for manufacturing 3D objects from woven fabric-based composite materials. The method includes a movable mold used to manufacture a complete object by tiling the object, instead of using a single monolithic mold. The method includes using an easily configurable digital mold matrix for the tiling mentioned above and a calibration unit configured to set the desired shape of a strip of the digital mold matrix surface. A digital file provides the information required for building the digital mold surface. A movable and adjustable pins matrix form a configurable support surface of the digital mold matrix. The configurable support surface of the digital mold matrix receives and supports the material from which the 3D object is built while tiling.

ZA202205295 (B) - COMPOSITION SUITABLE FOR 3D PRINTING

The invention pertains to a composition which is suitable for 3D printing, which composition comprises - a polyester derived from an aliphatic polyol with 2-15 carbon atoms and an aliphatic polycarboxylic acid with 3 to 15 carbon atoms, the polyester having an extent of polymerization, which is the ratio of the fraction of functional groups that have reacted to the maximum of those functional groups that can react, of at most 0.6, - solid filler, - diluent. The invention further pertains to a method for preparing a shaped object comprising the steps of - providing a composition as described herein, - extruding the composition through a printer nozzle to form a layer of the composition in a desired shape, building up the layers onto each other to form a shaped object, - subjecting the shaped object to a curing step to form a cured shaped object, wherein the curing step takes place during and/or after the extrusion step. The shaped object is also claimed.

CN221774804 (U) - 3D printing equipment for building industry

The utility model discloses 3D printing equipment for the building industry, which comprises a horizontally placed supporting base, a freely movable three-axis mounting frame is mounted above the supporting base, a printing head is mounted at the position of a transverse axis at the upper end of the three-axis mounting frame, a printing platform of a rectangular structure is mounted at the middle position above the supporting base, and the printing platform is mounted on the supporting base. And a separating mechanism is arranged on the front side of the supporting base, and the printed product is separated through the separating mechanism, so that the bottom face of the printed product is separated from the upper surface of the printing platform. According to the 3D printing equipment for the building industry, novel structural design is adopted, the separating mechanism is arranged, after a product (namely a building model) is printed, the product is moved out through the printing platform, the printed product and a separating steel wire move relatively in the moving-out process, at the moment, the printed product is cut through a thin steel wire, and the product is separated through the separating steel wire; therefore, the product is separated from the printing platform, and subsequent operation of workers is facilitated.

CN221736496 (U) - Rotary discharging device for concrete 3D printing

The utility model belongs to the technical field of rotary dischargers, particularly relates to a rotary discharger for 3D printing of concrete, and aims to solve the problem that the spraying angle is inconvenient to adjust in the prior art, and adopts the following scheme that the rotary discharger comprises a shell, a mounting groove is formed in the shell, and a connecting gear ring is arranged in the mounting groove; an adjusting pipe is fixedly installed on the connecting gear ring, a calling-out mechanism is arranged in the shell and comprises a first motor, the first motor is fixedly connected with the shell, a rotating rod is fixedly installed on an output shaft of the first motor, an arc gear is fixedly installed on the rotating rod, and the arc gear is meshed with the connecting gear ring; a second motor is arranged on the shell, a spiral feeding machine is fixedly connected to an output shaft of the second motor, and an angle adjusting mechanism is arranged in the adjusting pipe. According to the spraying device, the spraying angle can be conveniently adjusted, a needed building shape can be accurately sprayed, and the spraying device is easy to use and convenient to operate.

CN118639869 (A) - 3D printing concrete construction method based on cooperative work of double unmanned aerial vehicles

The invention discloses a 3D printing concrete construction method based on cooperative work of double unmanned aerial vehicles, based on a building unmanned aerial vehicle and a cruise unmanned aerial vehicle, the building unmanned aerial vehicle forms a required building structure through layer-by-layer stacking of printing strip bundles according to a preset printing path; in the printing process, printing strip pictures are collected in real time through an image collection system integrated on the cruise unmanned aerial vehicle, monitoring results are fed back to the building unmanned aerial vehicle in real time for printing parameter adjustment after the printing strip pictures are processed through an image analysis system, and intelligent monitoring and control over the whole 3D printing process are achieved. The unmanned aerial vehicle technology, the 3D printing technology and the artificial intelligence technology are combined, and the system is particularly suitable for ocean engineering, narrow construction space or complex construction terrain and other special environments where large machines are difficult to enter; meanwhile, through the printing quality real-time regulation and control system based on computer vision, the overall printing quality can be controlled, industrial and intelligent development of the whole construction process is facilitated, and the construction efficiency and the intelligent level of the construction industry can be improved.

CN118617546 (A) - Real-time reducing 3D printing head suitable for lunar surface in-situ construction

The invention relates to the technical field of building 3D printing, and discloses a real-time reducing 3D printing head suitable for lunar surface in-situ construction, which comprises a printing head, an adjusting plate, a supporting piece and a driving device, the top end of the printing head is fixed to a discharging port of the hopper, one end of the driving device is fixed to the pipe wall of the hopper through a supporting piece, and the other end of the driving device is fixed to the adjusting plate. The adjusting plate is used for sleeving the printing head and can be driven by the driving device to linearly move up and down to change the diameter of an outlet of the printing head. The diameter of an outlet of the 3D printing head can be automatically adjusted in real time to change the sectional dimension of an extruded mortar strip, and the sectional dimension of the mortar strip can be controlled by accurately and continuously changing the diameter.

US2024352410 (A1) - NANOFIBERS AND THEIR USE IN ENHANCING PARTICLE-BASED HYDROGEL SCAFFOLDS FOR REGENERATIVE MEDICINE AND TISSUE ENGINEERING

Provided are stable hydrogels systems with polymeric fibers and method of preparation thereof. Advantageously, the present hydrogel systems can have improved stability without the need of covalent crosslinking between the fibers. Due to their unique mechanical properties and stability, the present hydrogel systems may be useful for a wide variety of applications, including 3D printing, tissue engineering, regenerative medicine, drug delivery, and implantation.

CN221022342 (U) - Device for 3D printing of traditional Chinese medicine ointment

The utility model discloses a traditional Chinese medicine ointment 3D printing device which comprises a base, a placing plate is arranged above the base, a printing head is arranged above the placing plate, a driving assembly used for driving the placing plate and the printing head to move is installed on the surface of the base, and the traditional Chinese medicine ointment 3D printing device further comprises a cooling assembly arranged on the placing plate, the air blower is used for blowing and cooling a printing area on the placing plate; one end of the lifting part is connected with the cooling assembly, and the lifting part is used for adjusting the air blowing position of the cooling assembly; the cooling assembly is arranged on the placing plate, so that the printed ointment on the placing plate can be blown to quickly cool and dissipate heat, the printed ointment is helped to be shaped, collapse and deformation are avoided, the ointment at different heights can be adaptively blown to cool under the mutual cooperation of the lifting piece, and the unguent printing device is convenient to use and high in practicability. The application range of the device is widened.

CN117718098 (A) - Production line for medical 3D printing material processing

The invention relates to the technical field of medicine, in particular to a medical 3D printing material processing production line which comprises a frame body, a smashing mechanism, a stirring mechanism and a screw extruder, the smashing mechanism and the stirring mechanism are arranged on the frame body, the output end of the smashing mechanism is connected with the stirring mechanism, and the output end of the stirring mechanism is connected with the screw extruder. The screw extruder is installed on the frame body, raw materials are crushed into raw material powder through the crushing mechanism, the raw material powder and the additive are mixed in the stirring mechanism to form a mixed raw material, and the screw extruder heats the mixed raw material and extrudes the mixed raw material to form the 3D printing material, so that the process of printing material manufacturing is completed in one device. The frequency of repeatedly transferring the raw materials among a plurality of processing devices is reduced, and the working efficiency of the device is improved.

A Brief Timeline of 3D Printing History:

- 1960s – Inkjet technology is developed.
- 1971 – Johannes F. Gottwald patents the Liquid Metal Recorder device.
- 1980 – Dr. Hideo Kodama researches a liquid plastic that hardens upon light exposure.
- 1982 – Raytheon patents a powdered metal to combine layers.
- 1987 – Chuck Hull builds the world's first 3D printer.
- 2005 – Adrian Bowen builds the world's first self-printing 3D printer.
- 2006 – 3D printing hits home desktops.
- 2011 – Rapid expansion into today's current market.
- 2013 – Presidential endorsement of 3D printing.
- 2020s – New 3D printing attachments revolutionize the industry.

Bibliography

Figovsky Oleg Progress in 3D printing (116 pages) in the book "Development of science and technology", 2024. RUDN

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