In the bricks industry, shrinkage during manufacturing is closely monitored to assure that the final brick size is well-defined and complies with standardized dimensions, irrespectively of the raw material mix used in the given production.

Drying shrinkage is defined as the contracting of a freshly moulded green brick due to the loss of capillary water by evaporation and the particles of clay body have formed as a stable framework. All clay bricks, when formed, contain water which must be removed during a drying stage, before the bricks can be fired. This process must be carefully controlled so as not to stress the brick, which could lead to distortion and cracking. The rate at which a brick dries is controlled by adjusting at least temperature, humidity and air movement. The movement of air, controlled by fans, is used to help evenly distribute the air around the product and remove saturated air.

Firing shrinkage happens at the vitrification stage of the process for manufacturing bricks. This is due to diminished size of the particles as they approach fusion and to the closer arrangement of particles in their glassy matrix. The purpose of firing bricks is to transform the relatively weak dried clay into strong, durable bricks. The firing of bricks is a complex subject, because of the large difference in the types of clay used, in the methods of manufacture, in the types of kiln used and in the types of products. During the firing process reactions occur within the clay body, some of which transform the unfired body and develop the fired properties. The effects of firing on a clay body include shrinkage, weight loss, increased strength and a change in colour.

There is a need for providing economical building materials having additions and fillers which are cheap and which do not compromise the quality of the building materials, e.g. strength, non-toxicity for recycling etc. Also, there is a need for providing sustainable solutions for recycling the waste derived digestate from Municipal Solid Waste (MSW) processes comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes.

SUMMARY

In one aspect the present disclosure refers to a process for manufacture of a building material such as a ceramic building material comprising the steps of:

- mixing clay and/or sand with digestate obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes,
- optionally adjusting the water contents of the mixture,
- shaping the mixture,

- drying the shaped mixture, and
- optionally firing the shaped mixture,

so as to form said building material such as a ceramic building material. In one aspect, the present disclosure refers to a process for manufacture of a building material such as a ceramic building material comprising the steps of: - mixing clay and/or sand with digestate obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes, - optionally adjusting the water contents of the mixture, - shaping the mixture, - drying the shaped mixture, and - optionally firing the shaped mixture, so as to form said building material, wherein said digestate is selected from the group consisting of digestate directly obtained by said MSW process, dewatered digestate, dried digestate, and digestate ash.

In another example, there is disclosed a building material characterized in being manufactured by the process according to the disclosure.

In yet another example, there is disclosed a brick characterized in being manufactured by the process as disclosed herein.

In yet another example, there is disclosed a light weight aggregate characterized in being manufactured by a process as disclosed herein.

In yet another example, there is disclosed a material selected from concrete, a concrete additive, cement or mortar characterized in being manufactured from digestate obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes.

It has surprisingly been found that building materials which have been manufactured by a process where the total amount of raw materials comprises up to 30%w/w digestate on dry weight basis obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes exhibit good properties and provide a sustainable utility for recycling the digestate while saving pristine clay resources.

In one example, the building materials have been manufactured by a process where the total amount of raw materials comprises from 1%w/w to 30%w/w digestate obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of

MSW by addition of one or more enzymes on dry weight basis.

In some examples, colouring effects on ceramic building materials, e.g. bricks, can be avoided when using digestate as raw material. The digestate has also surprisingly been found superior to sewage sludge as raw material when manufacturing ceramic building materials at least for providing no discoloration, less shrinkage and/or higher end porosity.

In another example the building material is selected from the group consisting of bricks, light weight aggregates, tiles, floor tiles, roof tiles, wall tiles, drain pipes, sewer pipes, ducts, field drains, clay blocks, and pavers.

In another example the building material is mortar, concrete or cement. In concrete the digestate has been found to be beneficial for serving both as a filler and/or as having pozzolan properties, i.e. increasing strength of the hardened concrete. Furthermore, the digestate did not influence the setting time of the concrete negatively as typically seen for addition of sewage sludge ashes.

It is an object of the present disclosure to solve the disadvantages of the prior art. In particular it is an object of the disclosure to recycle waste components by use of digestate as raw material for building materials such as ceramic building materials without introducing severe colouring effects or severe shrinkage effects in said building materials. In a preferred example no severe colouring effects are observed for ceramic building materials such as bricks. Concrete materials comprising digestate ash according to the disclosure does in some examples have a reddish colouring.

CLAIMS

1. A process for manufacture of a building material such as a ceramic building material comprising the steps of:
   - mixing clay and/or sand with digestate obtained from a Municipal Solid Waste (MSW) process comprising liquefaction of the organic fraction of MSW by addition of one or more enzymes,
   - optionally adjusting the water contents of the mixture,
   - shaping the mixture,
   - drying the shaped mixture, and
   - optionally firing the shaped mixture,

   so as to form said building material,

   wherein said digestate is selected from the group consisting of digestate directly obtained by said MSW process, dewatered digestate, dried digestate, and digestate ash.
2. The process according to any of claim 1, wherein said building material is selected from the group consisting of bricks, light weight aggregates, tiles, floor tiles, roof tiles, wall tiles, drain pipes, sewer pipes, ducts, field drains, clay blocks, pavers, cement, concrete and mortar.
3. The process according to any of the preceding claims, wherein said digestate is obtained from MSW which has been degraded by microbial and enzymatic treatment to obtain a bioliquid which has been subjected to anaerobic digestion.
4. The process according to any of the preceding claims, wherein said digestate has a moisture content of at least 10%w/w, at least 15%w/w, at least 20%w/w, at least 25%w/w or at least 30%w/w.
5. The process according to any of the preceding claims, wherein said digestate has a moisture content in the range from 55%w/w to 95%w/w, or from 65%w/w to 75%w/w.
6. The process according to any of the preceding claims, wherein said digestate has a content of organic matter in the range from 45%w/w to 75%w/w on dry weight basis, or in the range from 50%w/w to 70%w/w on dry weight basis, or about 60%w/w on dry weight basis.
7. The process according to any of the preceding claims, wherein said digestate has a content of inorganic matter in the range from 25%w/w to 55%w/w on dry weight basis, or in the range from 30%w/w to 50%w/w on dry weight basis, or about 40%w/w on dry weight basis.

8. The process according to any of the preceding claims, wherein the firing temperature is from 900 degrees C to 1200 degrees C.