Method for Granulation of Marine Clay by Extrusion , Chemical and Physical Treatment to produce engineering soil

DESCRIPTION

TECHNICAL FIELD

The present invention relates to a method for mixing of soil stabilization agent with clay soil by integrating of extrusion, heating and chemical reaction into one single machine to produce engineering soil.

BACKGROUND ART

Traditional reclamation project was done with sea sand as the reclamation fill. The advantage of this fill is that it is easy to be pumped or dumped onto the target area. The properties of this fill can be easily controlled and the method to compact the sand to the required density are well established and well validated. However, the main difficulty of using this sand-fill method lies on the shortage of this sand-fill in Singapore waters, and the shortage and limitation of sand supply from the neighboring countries.

There are two folds in addressing these difficulties to obtaining suitable sand supply, they are:

a) Getting more sand supply from traditional and other non-traditional sources, and
b) Looking for alternative fill material suitable for this reclamation.

With regards to looking for alternative fill material, government agencies like JTC, HDB, MPA have been working in one way or another to handle this issue. 20 Years ago, NUS and MPA have researched into using “layered sand-clay scheme” of which lesser amount of sand is needed as part of fill volume is filled up by slurry clay dredged from the seabed. Subsequently, JTC also employed this concept in one of the reclamation site at Tuas accepting some “dredged clay or clay discarded from land-based excavated clay”. More recently, researchers in NUS and HDB also tried using dumpy clay in part of Tekong

reclamation. In addition, NUS and MPA also successfully pumping dredged clay mixed with small amount of cement and pumped into the large geotextile tubes and formed into a containment bund in Pasir Panjang Port extension works. All these works were technically successful, except that the clay fill needs to be further improved and it cost more money and the treatment is more time consuming. All these resulted in some time delay in the completion of our planned reclamation projects.

According to a recent announcement by the Minister of National Development, an estimated 8 m cu meters of excavated materials are produced every year from MRT work and general construction work. Some of the good earth is immediately being reused by the construction industry but the soft clay needs to be treated and can be used in land reclamation. There are abundant excavated materials that can be used in the Tuas reclamation project.

It is the object of the present invention to treat and recycle the excavated marine clay, in order to improve the properties of the marine clay. Thus the treated marine clay can be converted to engineering soil and used for reclamation, landfill and backfill.

SUMMARY OF THE INVENTION

The present invention provides a method for mixing of soil stabilization agent with clay soil by integrating of extrusion, heating and chemical reaction into one single machine to produce engineering soil. In this method, the marine clay or soft clay materials will be fed into the chamber of extruder and at the same time the pre-determined dosage of stabilization agent will be added into the chamber too. The extruder is designed to overcome the difficulties of mixing of marine clay by convenient mixer due to the stickiness of marine clay. During the extrusion process, the marine clay and stabilization agent will be well mixed and at the same time the excess of water in the marine clay will be reduced by the chemical reaction of quick lime and water as well as lime and marine

clay. The heat generated by the hydration of quick lime will also help on the evaporation of water in marine clay. A heating element along the extruder chamber will also promote the dewatering of marine clay. At the end of the extrusion, the water content of marine clay can be reduced from 50-60 % to 20-30% and the mixed product can be easily shaped. A disk with many holes of desired shapes and sizes (the holes on the disks can be different size and shape) was installed at the exit of the extruder so that desired shape and size of finished products can be produced. A wire cutter can be installed on the outer surface of the disk to cut the stabilized soil products into any length wanted.

By using the method of the present invention, the stabilized marine clay or any other soft clay can be used in a very short time (1-7 days) as engineering soil for reclamation, landfill and backfill economically and easily.

The invention also provides engineering soil products with simple production, low energy consumption and easy application.

DISCLOSURE OF THE INVENTION

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings.

The present invention covers a integrated extrusion machine with extrusion, heating and chemical reaction into one single process and special developed stabilization agent described in details as below.

The integrated extrusion machine illustrated in drawing 1 comprises two to three feeding hopers, one extrusion chamber with one to two extrusion screw, one discharging disc

with different form of holes and one cutting device to cut the treated soil noodle into the length required so that the desired sized and shape of engineering soil particles can be produced.

The procedure of treatment of marine clay into engineering soil in present invention can be as follows:

a) The marine clay collected will be fed into the marine clay hopper. At the bottom of the hopper a special mixer is equipped to promote the feed of marine clay due to the stickness.

b) A second hopper is used for feeding of stabilization agent. The stabilization agent is composed from a combination of sand, slag power, quick lime, cement, fly ash, bottom ash.

c) A single screw or twin screws (as illustrated in Fig.2) in the extrusion chamber will force the marine clay and stabilization to move forward and meanwhile the marine clay and stabilization agent will be mixed together thoroughly.

d) During the extrusion process, the excess water in the marine clay will be reduced by three actions:

   a. the reaction of quick lime with water will consume water;

   b. the heat released from the reaction between quick lime and water will evaporate water.

   c. the heat generated from the heater will evaporate water too.

   When the marine clay moved to the end of chamber, the water content in marine clay will be dramatically reduced.

e) The chemical and physical properties of marine clay will be changed during the process:

   a. chemical reaction of marine clay with lime;

   b. chemical reaction of cement and marine clay;

   c. chemical reaction of marine clay and slag powder or/and fly ash;

   d. the addition of sand and slag particles will improve the liquid and plastic limit of marine clay soil.

f) the die with many holes will make the soil treated like noodles with different shape. The size and shape can be easily adjusted by changing the holes on the die.

g) the wire cutter at the exit of the chamber will cut the soil noodles into the length desired, so that the finished product - engineering soil with different size can be produced.

CLAIMS

1. A integrated extrusion machine comprising few hoppers, a sealed extrusion chamber with a single or twin screws, a heating element around the chamber, a disc with many holes, and a wire cutter at the exit of the chamber in such way that the soft marine clay or any other clay soil can be treated in the machine into a engineering soil product with the size desired.
2. A marine clay loading hopper as claimed in claim 1, wherein a special mixer is equipped to promote the loading of marine clay into the extrusion chamber.
3. A sealed extrusion chamber with single or twin screws as claimed in claim 1, wherein the marine clay can be shifted and mixed with stabilization agent.
4. A heating element as claimed in claim 1, wherein the required heat can be generated to evaporate the water from marine clay.
5. A die with many holes as claimed in claim 1, wherein the size and shape of the holes can be different so that different soil noodles can be produced.
6. A wire cutter as claimed in claim 1, wherein the wire cutter can be installed at the exit of the extrusion chamber to that the engineering soil particles can be produced according to the desired length.
7. A marine clay stabilization agent, comprising a combination of sand, slag particles, quick lime, hydrated lime, cement or fly ash.