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(54) **Balance weight and manufacturing method for the same**

(57) The invention relates to a balance weight and a manufacturing method for the same using commercially available iron ore concentrate and compaction technology. The proposed solution, according to the invention is that the iron ore concentrate is compacted or a coupling matrice is added to it and then they are exposed to pressure and temperature depending on the specific coupling matrice chosen. Another method is using fluidized bath coating or electrostatic or electrokinetic coating of material on the base of polyethylene, high density polyethylene, low density polyethylene or another type of thermoplastic polyolefin, thus encapsulating the balance weight. These different production methods can be combined. The balance weight is used primarily for automatic washing machines, but also for machines and equipment, where damping unwanted vibrations or displacements of gravity is needed.

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Description

[0001] The present invention relates to a balance weight and manufacturing method for the same taking use of the iron ore concentrate in the primary forms and the compaction technology. The main balance weight application is for aggregate washing machines but also for the machines and devices where the damping unwanted vibrations or the compliance of centre is needed.

[0002] A widely used material for manufacturing of balance weights and wheel balancers in used aggregate washing machines of white goods is cast iron balance weights which are ideal for this application in light of characteristic density (7,2 g/cm^3), strength and shape integrality in context of aggregate washing machines design. However, disadvantages of this solution are the high difficulty of manufacturing, high casting costs and in specific instance the impossibility of achieving of required tolerance accuracy without additional machining. In summary their high price, despite the real ideal solution moves these balance weights into the minority segment of HIGH-END washing machines.

[0003] Most machines have concrete weights, which are making by oscillating manner in the form with the subsequent curing. The price frugality moves them like the majority solution for manufacturers of white goods despite a series of restrictions and disadvantages as their fragility, limit achievable density (3,6 g/cm^3), restrictions on the accessibility shapes and associated with structural constraints related to alone washing aggregate and correlative size needed space requirements. At present, efforts to increase density of concrete mixtures by adding of scalings of the treatment process of steel. However, these activities have the effect of reducing of strength and flexibility of weights.

[0004] There are described the possibility of meeting production of balance weights by the thermoplastic, respectively thermoset process when there is a hardening of the coupling matrice directly in the form where the panel is formed. However, this process has two simple restrictions on the use in the field of balance weights as the achievable compression pressure (density) and the achievable time for the reaction of thermoset, hardening.

[0005] In state of the art Chinese Patent Application No CN 1548615, the production of balance weight inside of drum machine is described consisting of powder mixture of plastic and iron in specific ratio depending on the weight to be balanced by. The balance weight is manufactured from mixture of molten plastic and iron powder in specific ratio and additional oil during melting. There is the significant shortening of the time of production by regulated ratio, same shape of balance weight but with different weight.

[0006] The balance weight based on dispersed metals such as iron, lead, copper, zinc, tin or a mixture of these metals bonded thermoplastic, thermosetting plastic or reactoplastic materials with precisely determined grain of dispersed metallic material and thermoplastic binders as polyethylene, polypropylene or polyvinyl chloride powder in liquid state in state of the art Slovak Utility Model Application No. 2375. There is the technology of manufacturing of balancing weight which has already kind of binders according to the following restrictions. If there is used thermoplastic materials like binder the restrictions are in from the view of achievable density because the used pressure fails to transform the individual fragments of dispersed metals. If reactoplastics or thermosetting materials are used as a binder then the time needed for their activation ie. Hardening is so long that the mere application of such a process becomes uneconomical.

[0007] Another point is that, without depending on the type of binder (thermoplastic, thermoset) production process in both case sis based only on the compaction principle of individual fragment of dispersed metal, what only reduces the distance but they are not transformed. It follows that achievable density is low, comparable to the existing concrete weights or in the case of application of clear dispersed metal, the achievable density would be high, however the costs to such material (clear dispersed metal) are in terms of actual utilization uneconomical.

[0008] In view of relatedness processes, previously used technology can divide into primary branches which consist of powder metallurgy, injection holding and thermoplastic or thermosetting process. The powder metallurgy is technology which uses high clear material with predefined dispersity on the input or in the case of several composite materials, but with the high purity of the material components of the input. These requirements imply high input costs in material security. The following process of manufacturing by powder metallurgy includes compaction of material so pressing of this material at relatively high pressures to prevent the porosity of the material and this metal pressing is subsequently sintered at a temperature closed to temperature of melting of sintered material or some of its composite components. Melting the material becomes compact and high strength. Analogously, the products of such technologies are relatively expensive. Metal Injection holding (MIM) is similar method of powder metallurgy. The difference is in the method of compaction (compression) of material, generally has many shortcomings such as high input material costs in terms of its purity, need to use lubricants in relation to the basic material to reduce abrasion and then also need to sinter so produced metal pressings.

[0009] Disadvantage of technical solutions for balance weight and manufacturing method for the same removes the proposed solution according to the invention, which is used the iron ore concentrate in primary form with Fe content greater than 64 wt% in. The mass fraction of Fe is more than 90% of body weight balancing. The iron ore concentrate in primary form contains many impurities, particularly oxides, which hinder its compaction. The balance weight and manufacturing method for the same according to the invention used the material which contains oxides partially reduced by DRI (Direct Iron Reduction)

for compaction. The effect of reduction of oxides is positive for compaction and especially at higher achievable density of balancing body. The iron ore concentrate is usually in the form of commercially available and creates the starting position of the invention.

[0010] The solution according the invention proposed for the balance weight and manufacturing method for the same the way that production takes place in compression utility to shape the future balancing of the body, into which is placed the iron ore concentrate and then it is put under pressure in the range 700 MPa - 1600 MPa to achieve the highest degree of transformation of the iron ore concentrate as particulate matter in the continuous substance. The result is then the possibility of release of compression pressing from compacting tool immediately after the application of compression pressure in regard to already achieved bond of individual particles. Operation cycle is accelerated thanks the option immediately after compressing to disengage of compression pressing from compacting tool compared with thermosetting process 4-16 times, as the dressing not to be remaining in the tool (form) where a reaction occurs ie. the heat curing. In this manner obtained bond between particles is sufficient for immediate disengage of pressing part from compacting tool but because of possible application of following process after compression. The adding epoxy resin or novolak type resin containing up to 5% by weight of balance weight input material as coupling matrices. The iron ore concentrate and adding coupling matrices are leaved open to temperature in the range 120°C - 200°C depending on the specific type chosen coupling matrices after compressing and releasing from the tool already out of tool in the shape of balance weight. The application of coupling matrices in the form of resins which as reactoplastic hardens after exposure to temperatures of defined range and creates a strong bond between individual fragments of iron ore concentrate makes homogeneity of balance weight.

[0011] The encasing of balance weight after compaction by fluid or electrostatic or electrokinetic application of 0,3 mm - 0,6 mm layers of material based on the high-density polyethylene, low-density polyethylene or another type of thermoplastic polyethylene. The continual encasing of balance weight into thin layer of polyethylene makes homogeneity of balance weight.

[0012] Use the mutual combination of the above procedures. The iron ore concentrate and added and the coupling matrice containing up to 5% of input material are put under pressure in the range 700 MPa - 1600 MPa and temperature in the range 120°C - 200°C depending on the specific type chosen coupling matrices to create the bond of fragments of iron ore concentrate of balance weight, then using the fluid encasing material on the base of polyethylene, high-density polyethylene, low-density polyethylene or another type of thermoplastic polyethylene up to 0,3 mm - 0,6 mm layers of material which creates the continual encasing. Another way the continual encasing can accrue on the balance weight from iron ore concentrate and coupling matrice by electrostatic or electrokinetic application of material up to 0,3 mm - 0,6 mm layers of material based on the high-density polyethylene, low-density polyethylene or another type of thermoplastic polyethylene.

[0013] The example of chemical composition of reduced iron ore concentrate, use of materials forming the base of the invention is as follows:

The component	Weight ratio
Fe	70,160%
SiO_2	2,630%
Al_2O_3	0,106%
CaO	0,107%
MgO	0,202%
S	0,048%
P	0,010%
K_2O+Na_2O	0,050%
CO_2	0,155%
TiO_2	0,024%
LOSS	0,248%
H_2O	9,900%

[0014] The embodiment of solution according of invention relates to the balance weight and manufacturing method for the same the way that the iron ore concentrate is placed into compacting tool where is realized a compression. The effective pressure to achieve the status of creating of bond between individual particles in the context of the required density 4,2 kg/dm^3 ranges 950 MPa - 1350 MPa. The iron ore concentrate obtained the shape of the future balance weight under pressure. Then there is a moulding release from the compacting tool by the ejection system.

[0015] Another embodiment of the balance weight and manufacturing method for the same according the invention is that the coupling matrice is applying to the iron ore concentrate for example novolak type resin containing up to 5% by weight of balance weight input material. The iron ore concentrate is mixing with coupling matrice and that is creating a composite mixture of materials. That way prepared mixture is transported to the compacting tool and there is a compression of the prepared mixtures of materials under pressure 700 MPa - 1600 MPa and there is getting the final shape of balance weight under pressure. Then there is a moulding release from the compacting tool by the ejection system. The mouldings already outside the tool could be cumulative transported through heating tunnel where the coupling matrice hardens and creates a strong link between fragments of iron ore concentrate after exposure to a defined temperature

range, thus makes homogeneity of balance weight.

[0016] In another embodiment of the balance weight and manufacturing method for the same is the iron ore concentrate transported to the compacting tool. There is a compression of the prepared mixtures of materials under pressure 700 MPa - 1600 MPa and thus getting the final shape of balance weight. Then there is a moulding release from the compacting tool by the ejection system. The mouldings already outside the tool could be cumulative transported through heating tunnel where are surface warmed up to the temperature around 160 °C. They are immersed into the fluidised bath after reached the temperature. There they are caught a layer of thermoplastic polyolefin in powder form. Then the mouldings are transported through the heating tunnel again and trapped particles of the thermoplastic polyolefin from the fluidised bath are melt and created the continual 0,3 - 0,6 mm thick layer of polyolefine on the surface, thus makes encapsulation of balance weight.

[0017] It is an object of embodiments of the invention to provide an improved solution where is the continual layer thick for example 0,5 mm of polyolefine on the surface of balance weight from iron ore concentrate created by electrostatic (corona) or electrokinetic (TRIBO) deposition.

[0018] The balance weight and manufacturing method for the same is can be used in various industries as industry production of household appliances, white goods. Use in mechanical and electrical engineering industry, concretely in the manufacture of balancing the head or blade for rotating equipment, particular shaft machine, weights for gravity displacement machine and devices of different types of lifts, cranes and lifting machine, to balance the ships, platforms and so on.

Claims

1. The balance weight and manufacturing method for the same for damping of unwanted mechanical vibrations and counterweight to the various technological devices **characterized in that** the used iron ore concentrate in primary forms containing Fe with iron content greater than 64 wt% and the mass fraction of iron represents more than 90% weight of balancing weight be issued compression pressure in the range 700 MPa -1600 MPa.

2. The balance weight and manufacturing method for the same according to claim 1, **characterized in that** the coupling matrice as reaktoplast in the form of epoxy resin or novolak type with content to 5% of input material of balance weight to the iron ore concentrate before compaction.

3. The balance weight and manufacturing method for the same according to claim 2, **characterized in that** the iron ore concentrate and the coupling matrice are exposed to the temperature in the range 120 °C - 200 °C.

4. The balance weight and manufacturing method for the same according to claim 1, **characterized in that** onto already compacted balance weight is fluidly applied material on the base of polyethylene, high density polyethylene, low density polyethylene or another type of thermoplastic polyolefin to 0,3 mm - 0,6 mm thick layer forming encapsulation.

5. The balance weight and manufacturing method for the same according to claim 1, **characterized in that** onto already compacted balance weight is electrostatic or electrokinetic applied material on the base of polyethylene, high density polyethylene, low density polyethylene or another type of thermoplastic polyolefin to 0,3 mm - 0,6 mm thick layer forming encapsulation.

6. The balance weight and manufacturing method for the same according to claim 1, **characterized in that** uses a combination of uses of coupling matrice according to claim 2, claim 3 and fluidized bath coating according to claim 4 or combination of uses of the coupling matrice according to claim 2, claim 3 and electrostatic or electrokinetic coating according to claim 5.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 1548615 **[0005]**