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PROCESS FOR THE DENSIFYING OF CONCRETE MASSES CONTAINING MATERIAL HAVING DIFFERENT PARTICLE SIZES BY MEANS OF VIBRATION

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It is previously known to work masses containing material in the form of grains or lumps by means of vibration, so that a compacting of the mass is effected. Since such masses, e. g. concrete, frequently contain particles (lumps, grains) of varying sizes, a certain grain class contained in the mass the particle size of which corresponds to the optimum influence of the frequency and amplitude of the vibration employed, will in a given case chiefly determine the densifying effect. It has also in practical work been found that when masses, such as concrete, which in addition to solid materials also contain liquid are vibrated, there is a different optimum vibrating effect for different vibrating frequencies at different moisture content in the mass. The employment of one single vibrating frequency will thus only in purely exceptional cases yield an optimum effect.

The present invention relates to a process of compacting water-containing concrete masses or grouts comprising material of different particle sizes, the compacting taking place while the mass is being cast or moulded, using so called internal vibration by means of vibrating devices, the characteristic feature being that the mass simultaneously or in immediate succession is subjected to vibrating impulses of different frequency. For practical reasons there is as a rule selected one frequency the optimum effect of which is adapted to compact small particle sizes, and another frequency which in the same way chiefly operates upon larger grains. At the same time the amplitudes of the frequency-impulses in question should preferably be adjusted in such a manner that optimum effect is obtained also in regard to the amplitude. A combination of low frequency and large amplitude will, for instance, produce a good escape of air bubbles from mixtures which are being compacted. The amplitude of the vibrating impulse also influences the range of action of the vibrating effect for which reason it may be advantageous to use a smaller amplitude on the higher frequency impulse than on the lower, in order to realize a more even penetration through the vibrated mass of the two vibrations in question. According to a special form of the invention the action of the impulse-giving device is thus adjusted by regulating the amplitude, preferably in such a manner that the respective penetration in the mass of the various impulses of different frequency approach a mutual uniformity.

These general principles are of course valid independently of the number of frequencies employed; thus more than two, e. g. three or four,

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being possible to use although, as already intimated for practical reasons as a rule only two frequencies are used which are suitably adjusted to produce optimal effect in respect to two main factors, e. g. the moisture content of the concrete mass and the grain class which is of deciding importance for its density, or the two grain classes in the mixture which are of the greatest importance for its density. At the same time it should as much as possible be strived to select such amplitudes that optimum effect will be obtained in accordance with what has been explained above. It is for instance of importance not only that the mass sediments or "settles" in a uniform way but also that enclosed air bubbles are driven out. As already explained, these processes may be regulated by means of the frequencies as well as by means of the amplitudes.

The selection of suitable frequencies and amplitudes is easily accomplished according to the above principles by direct trials on a mass having the composition of the concrete to be treated.

A multi-frequency vibration according to the invention may e. g. be accomplished by a simultaneous or successive employment of at least the same number of vibrating devices, e. g. so called rod-vibrators directly immersed in the mass, as the number of frequencies employed, in which case each implement operates with one of the desired frequencies, which deviates from the other ones. It is, however, also possible to use a single vibrator which is brought to vibrate with two or several frequencies according to wave-mechanical principles known per se, in which case a resulting curve is obtained the shape of which is composed of a fundamental and one or several superimposed frequencies.

I claim:

1. A process of compacting water-containing concrete masses comprising material having different particle sizes, by means of internally produced vibrations, said process being characterized by the fact that the mass prior to setting is subjected simultaneously to at least two vibrating impulses of different frequencies, and adjusting the amplitudes of the different vibrations so that the higher frequency vibration has the lower amplitude, whereby the penetrations in the mass of the respective impulses having different frequencies approach a mutual uniformity.

2. A process of compacting water-containing concrete masses comprising material having different particle sizes by means of internally produced vibrations, said process being characterized by the fact that the mass prior to setting is sub-

jected simultaneously to at least two vibrating impulses of different frequencies, one of said frequencies being adjusted to produce maximum compacting effect upon the smaller particle sizes in said mass and the other being adjusted to produce maximum compacting effect upon the larger particle sizes in said mass.

3. The process of claim 2 in which one of said vibration impulses is set up in one part of the concrete and the other vibrating impulses of a different frequency from a different source are set up simultaneously in a section of the concrete spaced apart from that of the first.

4. The process of claim 2 in which said vibration impulses of differing frequencies are superimposed and applied at the same points of the concrete mass.

5. In the process of compacting concrete grouts wherein a concrete grout is vibrated internally prior to setting with a plurality of frequencies simultaneously, the step which consists of adjusting one of said frequencies to a pre-determined period and amplitude which will produce substantially maximum densifying effect upon the grain class which is of deciding importance in producing density of the mass.

6. The process of claim 5 wherein two frequencies are employed, the higher of said frequencies having the lower amplitude.

7. In the compacting of concrete grouts, the process which comprises determining the frequency having a period and amplitude adapted to

produce substantially maximum densifying effect upon the grain class of the particular grout which is of deciding importance in producing density of the mass and internally vibrating the concrete grout simultaneously with said determined frequency and with another frequency prior to setting.

8. In the compacting of concrete grouts having different particle sizes, the process which comprises subjecting such a grout before setting to the simultaneous action of two frequencies having periods adapted to produce substantially maximum densifying effect on the smaller and the larger grain classes, respectively, of said grout and adjusting the amplitudes of the two frequencies so that the higher frequency has the lower amplitude whereby the penetrations in the mass of the respective impulses having different frequencies approach a mutual uniformity.

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