

UNITED STATES PATENT OFFICE.

WILHELM SCHWARZ, OF ZURICH, SWITZERLAND.

MANUFACTURE OF ARTIFICIAL STONE.

SPECIFICATION forming part of Letters Patent No. 670,299, dated March 19, 1901.

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To all whom it may concern:

Be it known that I, WILHELM SCHWARZ, a citizen of Switzerland, residing at No. 46 Weinbergstrasse, Zurich, Switzerland, have invented a new and useful Improvement in the Manufacture of Artificial Stone, of which the following is a specification.

My invention relates to the manufacture of artificial stones for building and other purposes, and in particular to the production of artificial calcareous sandstones. The manufacture of this character of artificial stone had not prior to my invention reached that state of development where it was possible to obtain a product of uniform character and of reliable strength and durability. Under the old methods there remained always an element of uncertainty as to the quality of the product resulting from each operation, and it was impossible to supply the market with building materials of fixed ratings.

It is one of the objects of my invention to eliminate this uncertainty from the manufacture of artificial stones of the character described and to enable the manufacturer to furnish products of a fixed and invariable character and of the greatest possible amount of strength and durability.

With this and other objects in view my invention consists in the method, steps, and features hereinafter described, and more particularly pointed out in the claims.

In the course of my experiments and researches in this direction I have found that the principal cause of failure to produce a satisfactory artificial calcareous sandstone consists in the varying conditions and states of moisture of the sand employed for this purpose, the sand being too moist at times and at others too dry. Sometimes the mixture of sand and lime is a wet and pulpy mass which is badly suited to being pressed or molded, while at others the opposite difficulty occurs—that is to say, the mixture contains an insufficient amount of moisture to completely slake the lime—in consequence of which the mass after hardening receives rents and fissures and generally deteriorates in consequence of the after-slaking. Owing to the natural moisture ordinarily existing in sand and to the combined action of this moisture and that of the atmosphere a chemical combination be-

tween the sand and the lime, resulting in the formation of calcium silicate, takes place in a certain measure; but the extent of this chemical action cannot be determined with any degree of certainty, because neither the amount of moisture in the sand nor in the atmosphere can be practically determined in each case. Hence it is extremely difficult, not to say impossible, to ascertain the exact quantity of moisture in the form of water or steam which must be added to insure the completion of the conversion of the lime into the silicate of calcium, the binding and hardening medium. This conversion must be complete when the last amount of moisture has been used up, for the reasons explained above. In other words, the quantity of moisture should be neither too great nor too small, because in either case an unsatisfactory product is obtained. This objection can be avoided only if means are offered whereby the quantity of moisture already present or to be added can be ascertained or computed beyond a peradventure, and thus the operator is enabled to start the process from a constant and fixed point. According to my invention this starting-point for the process is reached in an exceedingly simple manner by completely drying the sand and preferably also the lime before they are mixed and before the necessary moisture for silicization is added. Indeterminable quantities of moisture or water are thereby completely avoided and eliminated from the process, which may now be carried out with accurately determinable and certain quantities. The effect of the process is thus made absolutely certain and depends no longer on the skill and practical experience of the operator, but solely on calculation, the result being a calcareous sandstone of unvarying quality and homogeneity. Such result, moreover, was hitherto impossible of realization, even at the hands of highly skilled and experienced manipulators.

In carrying out my invention a certain quantity of sand—say one hundred parts, by weight—is dried by means of heat *in vacuo*, preferably in a vacuum-pan provided with revoluble wings or other means for subsequently mixing the sand with the other ingredients. I prefer a vacuum apparatus to

other means of drying, because I find that more economical, and for the further and very important reason that by drying *in vacuo* no air can have access to the sand. By preventing access of air no carbonic dioxid, which is always contained in the air, can come in contact with the materials to be mixed, which is a matter of considerable importance, since the carbonic dioxid would interfere with the silicization of the lime to be subsequently added. The employment of a vacuum also results in the removal of the air in the interstices of the sand, which air contains moisture and, moreover, would interfere with the formation of silicate of lime by preventing the otherwise more intimate contact between the lime and sand. After the sand has been completely dried I add thereto about two parts, by weight, of powdered or comminuted lime, which has preferably been completely dried previously, and the two substances are then completely mixed under the vacuum, whereupon moisture or water, preferably in the form of steam, is added and mixed with the sand and lime until the formation of the silicate of lime is complete.

Heating of the sand for the purpose of drying the same not only enables the process to start from a constant point, but it also opens up the silicic acid of the sand. The vacuum, which is maintained during all the stages of the process, prevents the access of carbonic acid or carbon dioxid to the lime, which would result in the formation of calcium carbonate, and hence seriously interfere with the combination of the silicic acid with the lime to form the necessary binding material—the silicate of lime. By introducing the water as steam the danger of introducing the carbonic acid with the moisture is avoided, and thus all avenues of access of the carbonic acid are cut off under the preferred embodiment of my invention.

The lime, while preferably dried, need in general not undergo special drying operations, because, in the first place, it is normally sufficiently dry, and, in the second place, its percentage of moisture bears a very insignificant ratio to the amount of moisture contained in the sand, as will appear from a consideration of the following example, taken from an actual working of the process: If we take one hundred kilograms of sand and allow for the same ten per cent. of moisture,

which is a reasonable estimate, borne out by practice, the same will contain ten thousand grams of water. If to this are then added two kilograms of lime, the amount usually required, and allowing for the same as much as five per cent. of moisture, the entire quantity of water contained in the lime would only amount to one hundred grams. This amount is so small that it plays a very unimportant part as compared with the moisture contained in the sand, and since the water contained in lime usually is much less than given above it may be safely neglected without materially interfering with the calculation of the moisture to be added to the dried sand to obtain a product of uniform quality.

What I claim, and desire to secure by Letters Patent, is—

1. The process of making artificial stone which consists in completely drying the sand *in vacuo*, then adding lime to the dried sand and mixing *in vacuo* and adding moisture thereto.

2. The process of making artificial sandstone, which consists in completely drying sand *in vacuo*, then adding dried lime thereto and mixing the ingredients *in vacuo* and adding moisture thereto.

3. The process of making artificial sandstone, which consists in drying the sand by heat *in vacuo*, then adding lime to the dried sand and drying the lime, then mixing the whole and adding moisture all while under a vacuum.

4. The process of making artificial sandstone, which consists in heating sand under a vacuum until completely dry, then adding dried lime, and mixing both substances while maintaining the vacuum, and then adding to the mixture a predetermined quantity of moisture and again mixing all under a vacuum.

5. The process of preparing artificial sandstone, which consists in heating sand under a vacuum until completely dried, then adding thereto lime, then mixing *in vacuo*, then introducing a predetermined quantity of steam to the mixture and again mixing all *in vacuo*.

In witness whereof I have hereunto set my hand in presence of two witnesses.

WILHELM SCHWARZ.

Witnesses:

WM. WOFFLERS,

ALFRED BAERWOLFF.