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(54) **Automatic system for setting the density and viscosity in products obtained by continuous grinding**

(57) It consists of continuously measuring the moisture from the mixture of solid raw materials entering the continuous mill, wherewith the required amount of supply water may be calculated. If suspended materials are supplied, the solid content measurement in the suspension is needed. Therefore, maintaining the viscosity of the final

barbotine in steady values is expected.

The density and viscosity will also be measured in the barbotine resulting from the grinding, by using a continuous system, not in-line, i.e. performing a sampling of the barbotine for maintaining a continuous measurement.

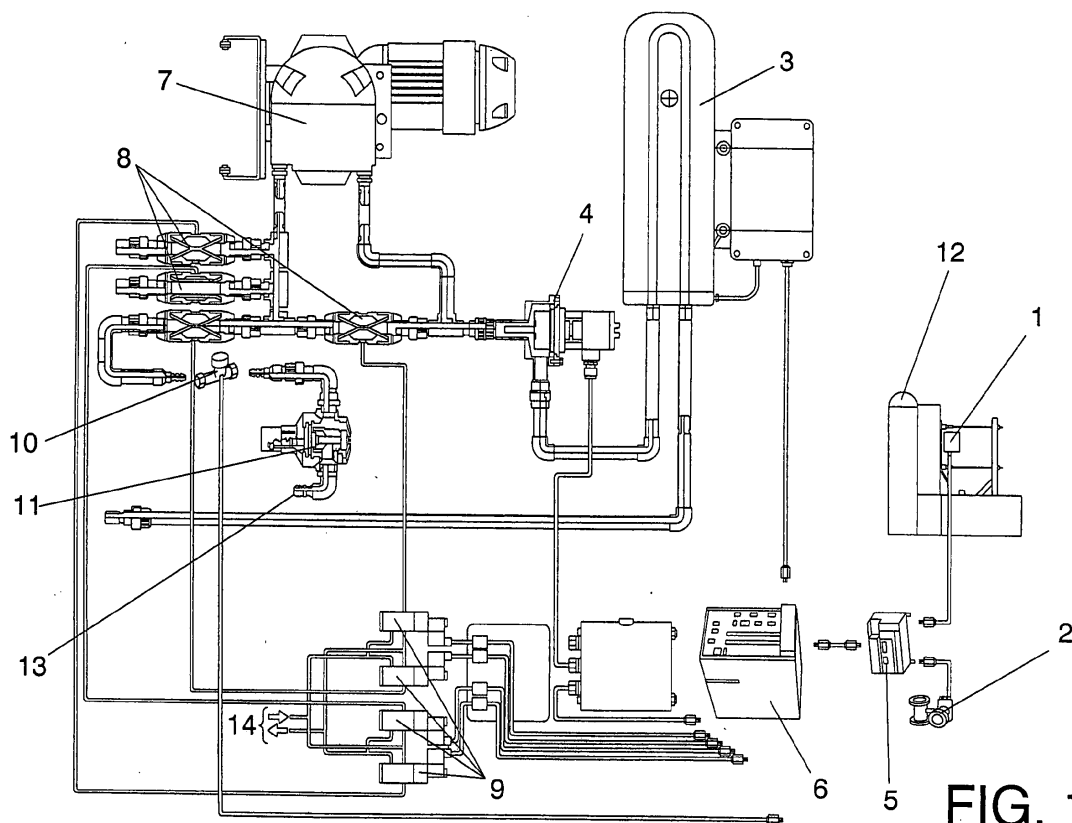


FIG. 1

Description

OBJECT OF THE INVENTION

[0001] The present invention, as this specification states in its title, relates to an automatic system for setting the density and viscosity in products obtained by continuous grinding, being especially applied in the field of the ceramics sector but also in any sector wherein the continuous wet grinding is used.

[0002] The solution being set forth has an immediate application in continuous grinding because it improves the quality and control of the supplying process. This will allow eliminating the reworks for correcting the characteristics of the barbotine once in the pool, as long as deviation allows this, such as for example a high density that can be corrected by adding water. On the other hand deviations difficult to be corrected may exist, as would be the case opposite to the previous one wherein the density was below the set point in which case the only way for recovering is by adding it to barbotine pools with a density higher than that of the work.

[0003] It can also be used for atomizing that barbotine outside the working parameters, but of course in that case the next step of the process which is the atomization will be affected, being affected both in terms of productivity and quality, low barbotine density leads to fewer tons/hour of atomizer production, and when it comes to quality the particle size of the atomized material will not be within the correct parameters, for example.

BACKGROUND OF THE INVENTION

[0004] Currently there is not known any operating system that automatically performs this setting on the density and viscosity, or even continuously measuring the variables. Currently, measurements of the barbotine resulting from grinding are carried out periodically and manually by the operator, which means that there will be differences in the results obtained from different operators.

[0005] With the result obtained by the operator, the decision on changing the setting in case the characteristics of the barbotine resulting from the grinding had changed, or otherwise, waiting a while for repeating again the measurements and confirming that a change in the characteristics of the barbotine really exists for then making a correction, should be taken. All of this bearing in mind that the conditions at the mill inlet which produced that result were those presented about two hours ago, and which may have varied with respect to this time. This gets complicated when there is more than a supply to the mill, as in the case of supplying suspended materials, due to the difficulty of knowing which of the supplies have changed its conditions.

[0006] Anyway there is known what is situation is at that moment, but what is not known is since when conditions have changed, in other words, when the change occurred. Depending on the time when the change oc-

curred, the amount of barbotine produced outside the control parameters will vary, wherewith it will have a greater or lesser influence in the process, also depending on the intermediate barbotine storage existing for the homogenization. Furthermore, by unknowing the exact time in which the change occurred the causes leading to it are difficult to be ascertained.

DESCRIPTION OF THE INVENTION

[0007] In general terms, the automatic system for setting the density and viscosity in products obtained by continuous grinding, object of the present invention, involves a solution based on continuously measuring the moisture from the mixture of solid raw materials entering the continuous mill, wherewith the required amount of water to be supplied could be set, so that water has to be also measured. In case of supplying suspended materials such as can be recycle sludge or any diluted raw material, it will be required to measure the solids content in that suspension, by being another source for possible variations in the amount of water supplied to the mill. Therefore, maintaining both the viscosity and density of the final barbotine in steady values is expected.

[0008] Subsequently the density and viscosity in the barbotine resulting from the grinding will be measured by using an off-line system, i.e. equipment that enables carrying out a sampling of the barbotine in order to maintain a continuous measurement, while minimizing the wears caused by the abrasive action of the barbotine and facilitating the controlled cleaning of sensors.

[0009] In order to carry out these measurements the technologies to be used are:

- To measure the moisture from raw materials, microwave technology will be used, by being independent of the colour, density and particle size of the mixture to be measured.
- To measure the water flow rate, an electromagnetic flowmeter will be used.
- To measure the density, the technology for measuring the oscillation period of a mechanical oscillator through which the barbotine sample circulates is used. The oscillation period depends on the density of the sample within the mechanical oscillator, and on the mechanical properties of the oscillator.
- For the viscosity a vibrating sensor providing a signal proportional to the viscosity is used.

[0010] With these measures the expected results to be obtained are:

- Moisture measurement of raw materials with an accuracy of 0.1 %.
- Density measurement with an accuracy of 0.01 g/cm³.
- Static viscosity measurement comparable to that measured in Ford cup No. 4.

- Density stabilization set pointed in $+ 0.01 \text{ g/cm}^3$.
- Viscosity stabilization set pointed in Ford cup No. 4 ± 2 seconds.

[0011] In order to facilitate the understanding of the characteristics of the invention and being an integral part of this specification, a sheet of drawings is attached, in sole figure of which, with an illustrative and not limitative manner, the following has been represented:

BRIEF DESCRIPTION OF THE FIGURES

[0012] Figure 1. - It is a scheme for carrying out the installation of an automatic system for setting the density and viscosity in products obtained by continuous grinding, according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Referring to the numbering adopted in the figure, it can see how the automatic system for setting the density and viscosity in products obtained by continuous grinding, proposed by the invention, uses the following components:

- Measuring equipment:
 - Sensor 1 for measuring the moisture from the mixture of raw materials.
 - Electromagnetic flowmeter 2 for measuring the supply water flow rate.
 - Densimeter 3 for measuring the density from the barbotine and suspended supply if any.
 - Viscometer 4 for measuring the barbotine viscosity.
- Equipment for controlling the information management and storage processes:
 - Programmable automaton 5 with different functions:
 - Capturing moisture data.
 - Control loop for the setting.
 - Managing the barbotine sampling.
 - Managing controlled cleaning system.
 - Industrial computer 6.
- Equipment for sampling and circulating the barbotine:
 - Peristaltic pump head 7 with adapted engine mechanization.
 - System for cleaning the sensors and circuit.
 - Sleeve valves 8 for avoiding clogging and wearing, automatically actuated ball valves

may also be mounted.

- Pneumatic solenoid valve 9 for actuating the valves 8.
- Flowmeter 10 for controlling the cleaning water.
- Cleaning water pressure regulator 11.

- Small electrical material required for operating of the previous elements.
- All of the above mounted on a PVC or stainless steel circuit inside a cabinet with wheels, so that the prototype can be autonomous and transportable.

[0014] The first objective is to maintain the density and viscosity in steady values, for which the setting would be needed when raw materials enter the continuous mill. This is important because the residence time of the barbotine inside the mill is very high. So that, if the setting were made based on the reading of the barbotine density, there is a risk that the conditions of raw materials that caused that density found at the outlet be the same conditions entering at this time in the continuous mill. This shift in time can cause an instability even greater than that which may exist through normal supply of raw materials, water, and deflocculant.

[0015] In order to achieve this stability, the commercially available sensors for achieving a sufficiently precise measurement of the amount of water of raw materials both solid and diluted at the continuous mill inlet have been adapted.

[0016] Furthermore, at the continuous mill inlet other important data such as the weight or flow rate of raw materials supplied to the mill has been provided. This data is obtained through a dosing belt 12 provided with weighing cells, in case of raw materials supplied in solids, and a mass flowmeter for supplied diluted raw materials.

[0017] At this point the information required for calculating the amount of water needed to be supplied is provided. The water will be set by using the system available when installing the mill (automated control valve, peristaltic pump ...) and it will be measured using a flow meter providing the required accuracy. Through this setting of the water supply, an steady density is expected to be maintained, since the proportion of different raw materials is assumed constant, and fluctuations that may occur in the flow rate of raw materials entering the mill can be balanced with the setting of water flow rate, by having these under control using the extracting/dosing belt 12. The scheme also indicates the cleaning water inlet 13 and the air inlet and outlet 14.

[0018] As for the viscosity, if the factors that can modify thereof are reviewed, it is basically found:

- Properties and percentage of components in the formula.
- Properties and amount of deflocculant being dosed at the mill inlet.
- Amount of water supplied by raw materials.

- Amount and quality of water added to the grinding.

[0019] From all these influences some are measured, and therefore they should remain constant such as the formula composition, quality of water supply and defloculant, constancy of the properties raw materials. Therefore, it is known that the amount of water supplied by raw materials can vary, and moreover it is not measured today. That is, if water supply is properly set the viscosity will also be maintained steady.

[0020] In spite of everything discussed above, a measurement of the density and viscosity after grinding will also be required, for which commercially available sensors for achieving a sufficiently accurate measurement have been adapted. This will involve a quality control of the process, but that control will also be necessary so as that steady density and viscosity values be close to the set point values to be followed by the process.

[0021] It is a huge assumption that all variables that had been supposed to be constant really are over time; as for example, the accuracy of the defloculant supply or even its behaviour with respect to plastic raw materials, there is also the possibility of reading deviation of the moisture from raw materials, including the load cell of the weighing belt.

[0022] By using this system density and viscosity deviations are detected, by recording these deviations in the readings and also the changes in the settings, the operator can find what problem is causing the deviation, since, the system corrects the effect of these problems on the density or viscosity, but does not correct the problem itself. While finding out which of the working conditions has been deviated, it is ensured that the density and viscosity will be within the control parameters, since by having several possibilities the solution to the problem may not be immediate. Of course, when the deviation is corrected, the system must be able to detect the new change and redirecting the process, usually with a correction in the direction opposed to the previous one.

Claims

1. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, especially applicable to the technical field of the ceramics industry, and generally to any field wherein continuous wet grinding is used, wherein said density and viscosity are intended to be known, and wherein a continuous mill is provided with at least one raw materials and water supply inlet and at least one obtained product outlet, so-called barbotine after grinding; **characterized in that** it includes:

- means for continuously measuring the moisture (1) from the mixture of solid raw materials entering the continuous mill;

- means for measuring the amount of water (2) required to be supplied;
- means for measuring the density and viscosity (3, 4) from the resultant barbotine at the referred mill outlet;
- an equipment for controlling the information managing and storage processes (5, 6);
- an equipment for sampling and circulating the barbotine (7 to 11, 13, 14);
- an equipment for measuring weight and flow rate of raw materials supplied (12) to the mill.

2. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to claim 1, **characterized in that** in addition to the aforementioned means and equipments it comprises means for measuring the solid content in raw materials entering the mill for the cases in which suspended materials are supplied to these raw materials entering the mill.

3. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to claim 1 or 2, **characterized in that** said measuring means and equipments are mounted on a PVC or stainless steel circuit inside a cabinet with wheels facilitating the autonomy and transportability of the system.

4. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND **VISCOSITY** **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** the means for continuously measuring the moisture from the mixture of solid raw materials entering the mill consists of a humidity sensor (1) using microwave technology facilitating the measurements independently of the colour, density and particle size of the mixture.

5. AUTOMATIC SYSTEM FOR **SETTING** THE DENSITY AND VISCOSITY **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** the means for measuring the amount of water supply consist of an electromagnetic flowmeter (2).

6. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY **IN** PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** the means for measuring the barbotine density and viscosity consist of a densimeter (3) using technology for measuring the oscillation period of a mechanical oscillator, and a viscosimeter (4) using a vibrating sensor providing a signal proportional to the viscosity.

7. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY IN PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** equipment for controlling the information managing and storage processes comprises an industrial computer (6) and a programmable automaton (5), which includes functions for capturing moisture data, control loop for the setting, managing the barbotine sampling, and managing controlled cleaning system. 5 10
8. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY IN PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** the equipment for sampling and circulating the barbotine has a peristaltic pump head (7) with adapted engine mechanization and a system for cleaning the sensors and circuit, wherein it is included: 15 20
- sleeve valves (8) for avoiding clogging and wearing, or automatically actuated ball valves;
 - pneumatic solenoid valves (9) for actuating the mentioned valves (8) with air inlet and outlet (14); 25
 - flowmeter (10) for controlling the cleaning water;
 - cleaning water pressure regulator (11) with cleaning water inlet (13). 30
9. AUTOMATIC SYSTEM FOR SETTING THE DENSITY AND VISCOSITY IN PRODUCTS OBTAINED BY CONTINUOUS GRINDING, according to any one of the preceding claims, **characterized in that** equipment for measuring the weight and flow rate of raw materials supplied to the mill comprises a dosing belt (12) provided with weighing cells, for materials supplied in solids, and a mass flowmeter for supplied diluted raw materials. 35 40

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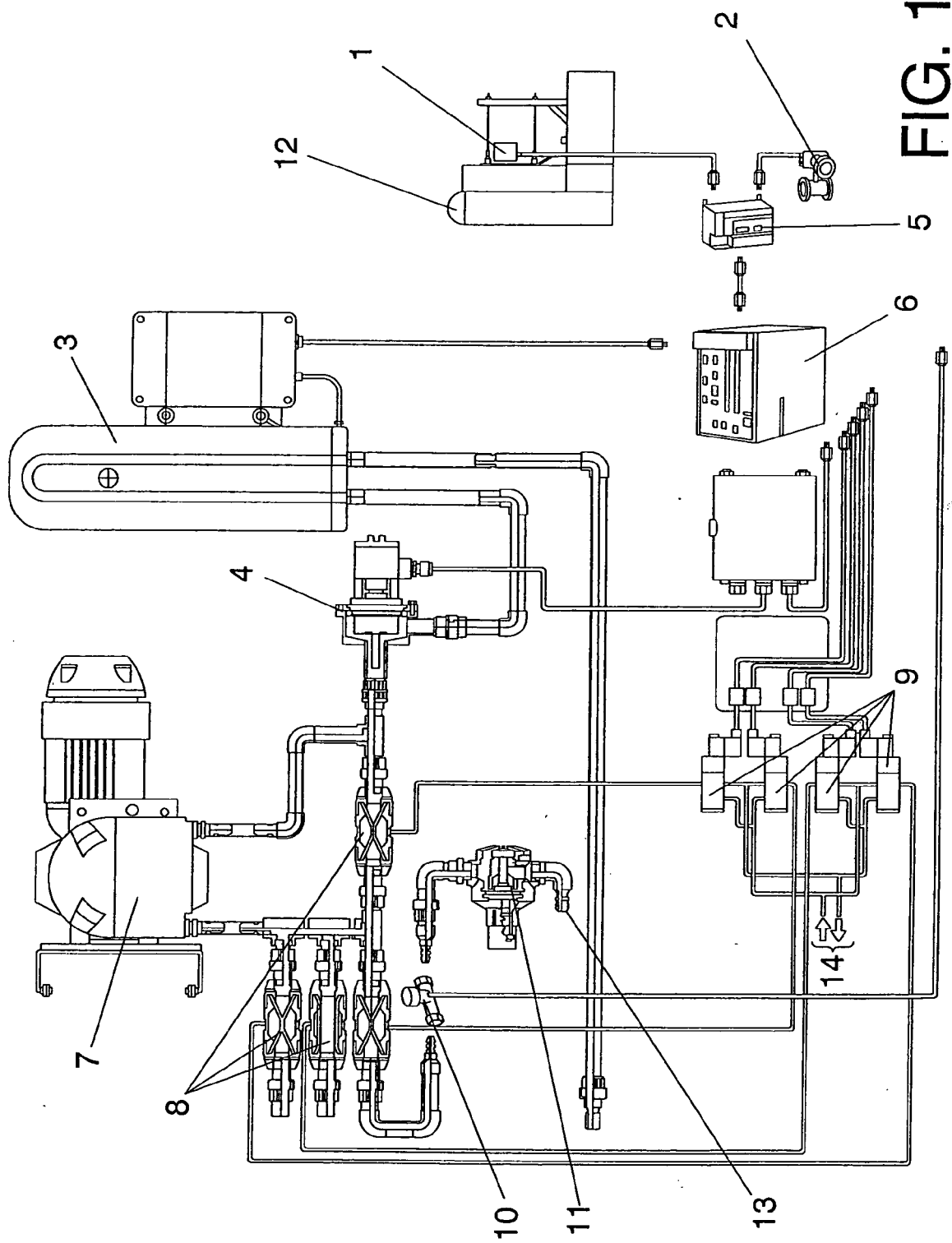


FIG. 1



EUROPEAN SEARCH REPORT

Application Number
EP 10 38 0154

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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1	Place of search Munich	Date of completion of the search 29 June 2011	Examiner Kopacz, Ireneusz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 38 0154

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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29-06-2011

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