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(54) **Method for the operation of a dishwasher with program control**

(57) The invention concerns a method for the operation of a dishwasher with program control, in which the program steps are variable depending on the degree of opaqueness of the washing solution. The cleaning effect is optimised with a minimum expenditure of time and energy in that a first program structure can be selected for easily cleaned domestic soiling and a second program structure can be selected for burned-on and/or dried-on domestic soiling, in that the degree of opaqueness of the washing solution is measured by means of an optical sensor according to transparency and foam formation, in that in the first program structure at least the washing duration is varied in the program steps and in that in the second program structure the washing solution is heated to a defined temperature, at least in pre-washing.

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Description

[0001] The invention concerns a method for the operation of a dishwasher with program control, in which the program steps are variable depending on the degree of opaqueness of the washing solution.

[0002] A multiplicity of methods of this type are known, which use the measured opaqueness values of the washing solution to control the program, as disclosed e.g. by DE 42 43 868 C2, DE 36 26 351 C2 and DE 42 19 276 A1. These washing programs are generally designed as universal programs, i.e., they adapt to the particular ascertained dirtiness of the washing solution and, for successful cleaning of the items to be washed, are supposed to deal with all types of soiling that occur. This, however, is not in any way assured for all types of soiling that occur.

[0003] Essentially, two types of soiling can be distinguished. On the one hand, there is an easily cleaned domestic soiling. The soiling can then be cleaned relatively easily with a small expenditure of time, temperature, and water. Such soiling occurs, for example, in the case of cold foodstuffs or in the case of foodstuff residues which have not dried on. The second type of household soiling can be cleaned only with difficulty, e.g. in the case of foodstuff residues which have burned on or which have dried on to the items to be washed over a fairly long period of time.

[0004] The disadvantage of the known methods with optical detection of the opaqueness of the washing solution is that soiling which is not yet present in the washing solution is invisible to the sensor. A further disadvantage is the inadequate measurement resolution.

[0005] Burned-on soiling residues which are gradually released from the items to be washed are very small by comparison with the soiling which is already released, and therefore cannot be measured in the majority of cases. Due to these disadvantages, in the case of the known methods the washing process must always be designed so that even hard, burned-on soiling is cleaned. Consequently, the washing programs cannot be optimised to a minimum amount of time, temperature and water consumption by means of sensor control. Otherwise, a satisfactory cleaning result would not be achieved in the case of burned-on soiling.

[0006] The object of the invention is to create a method, of the type initially referred to which can always be optimised to a minimum in respect of time, temperature and water consumption, irrespective of the nature of the soiling, without the need to dispense with a satisfactory cleaning result.

[0007] This object is achieved, according to the invention, in that a first program structure can be selected for easily cleaned domestic soiling and a second program structure can be selected for burned-on and/or dried-on domestic soiling, in that the degree of opaqueness of the washing solution is measured by means of an optical sensor according to transparency and foam forma-

tion, in that in the first program structure at least the washing duration is varied in the program steps and in that in the second program structure the washing solution is heated to a defined temperature, at least in pre-washing.

[0008] The method according to the invention provides for two different program structures, which are optimally adapted to the two main types of domestic soiling that occur. The user can contribute significantly to the optimisation of the washing process through selection of the program structure according to the loading of the dishwasher with the correspondingly soiled items. Further optimisation is effected by the measurement value, measured by the sensor, for the transparency of the washing solution present, at least the washing duration being variable in the first program structure in dependence upon it and a defined, preferably raised temperature of the washing solution being used in the second program structure, at least in the pre-washing phase.

[0009] In the case of the first program structure for easily cleaned domestic soiling, the soiling is rapidly removed from the items to be washed by the mechanical action of the water jet. Burned-on residual soiling is not anticipated in this case. Consequently, it is possible for the washing duration in the respective program steps to be adapted according to the measurement values of the opaqueness sensor. In the case of a low opaqueness value, the shortest possible washing duration is selected in the respective program steps. In the case of medium and high opaqueness values, the washing duration is prolonged accordingly. Changing of the water between the different program steps can be either inhibited or effected depending on the measured opaqueness of the washing solution, in order to minimise the water requirement. A defined quantity of water can be added in each program step in the case of a large amount of foam being formed. By this means, the washing process is stabilised and the cleaning performance is maintained and even improved. A separate sensor can be provided for this purpose, to measure the reflection of the washing solution or the instable pressure of the circulating pump, for the purpose of deriving a corresponding measurement value.

[0010] In order to clean burned-on or dried-on foodstuff residues from the items to be washed, more time and energy is required than is the case for easily cleaned items. This fact is dealt with by the second program structure. In this program structure, the time parameter is not influenced towards the achievement of a shortest possible washing duration. Rather, in this case, the program is varied within a time-frame depending on the sensor measurement values so as to achieve an optimum cleaning result using the smallest possible amount of water and electrical energy.

[0011] A crucial feature of the second program structure for "intensive cleaning" is the heating of the washing solution during pre-washing to a defined, preferably

higher temperature than in the first program structure. At this temperature, of e.g. °C, the majority of foodstuff residues, particularly greases, are removed from the items to be washed. In combination with an addition of a portion of the cleaner during pre-washing, a good cleaning effect is then already achieved. If a high level of opaqueness of the cleaning solution results from the cleaning action during pre-washing, then a large part of the soiling present on the items to be washed is removed in the subsequent program step. Consequently, in the subsequent program step, the cleaner chemistry can act almost entirely on the soiling still adhering to the items to be washed. This improves the cleaning effect. By contrast, if only a small degree of opaqueness of the washing solution is measured during pre-washing in spite of heating of the washing solution and the use of a portion of the cleaner, it can be assumed that a portion of the foodstuff residue is still adhering strongly to the items to be washed. If such a cleaning situation occurs, then in the case of the second program structure the pre-washing program step can be discontinued after a minimum time. In this case, a change of water before the next program step can be omitted. In the case of a large opaqueness value, however, the quantity of water is varied.

[0012] If the pre-washing is discontinued after the minimum time due to only minimum opaqueness of the washing solution, the pre-washing time saved can then be added to the subsequent program steps, since the time-frame for the overall washing process remains unchanged. There is then a high degree of time flexibility in the following program steps. It is then possible to prolong different program steps = washing steps without exceeding a defined time limit.

[0013] If a household possesses a hot-water connection, the required temperatures can be reached more rapidly in the program steps with heating of the washing solution than is possible in the case of dishwashers with a cold-water connection. The time saved in the heating steps through the hot-water connection can be added to other program steps of the washing process depending on the sensor measurement values.

[0014] A further advantage of the method according to the invention is the compatibility of the sensor-controlled programs with commercially available cleaners. In the cleaning program step, the parameters of temperature, number of temperature steps and the hold times following attainment of the temperature can be adapted to the different commercially available cleaners. Matching of the programs to new types of cleaner can be effected by the input of data into an electronic data memory (EEPROM). Using the data stored in the memory, the sensor-controlled programs can optimally set the cleaning times for the current cleaner type depending on the sensor measurement values of the program step just executed and/or the preceding program steps.

[0015] The sensor measurement data can also be used to determine whether and how many intermediate

washing steps are to be performed. Finally, water can also be added depending on the sensor measurement data and this addition can be effected in each program step. Water is always added whenever the sensor measurement value attains a predefined threshold value. The addition of water always means an adaptation of the water quantity to a difficult cleaning situation (high degree of opaqueness and/or foam of the washing solution) and serves to improve and optimise the cleaning result.

Claims

1. Method for the operation of a dishwasher with program control, in which the program steps are variable depending on the degree of opaqueness of the washing solution, characterised in that

a first program structure can be selected for easily cleaned domestic soiling and a second program structure can be selected for burned-on and/or dried-on domestic soiling, the degree of opaqueness of the washing solution is measured by means of an optical sensor according to transparency and foam formation, in the first program structure at least the washing duration is varied in the program steps, and in the second program structure the washing solution is heated to a defined temperature, at least in pre-washing.

2. Method according to Claim 1, characterised in that

in the first program structure the washing duration is varied depending on the measurement values measured by the sensor.

3. Method according to Claim 1 or 2, characterised in that

changing of the water between the program steps can be either inhibited or effected depending on the measured opaqueness in the first program structure.

4. Method according to one of Claims 1 to 3, characterised in that

in the case of a large amount of foam being formed in the first program structure a defined amount of water can be added to each program step.

5. Method according to one of Claims 1 to 4, characterised in that

in the second program structure, the cleaning can be optimised using the smallest possible amount of water and energy in the pre-defined time-frame depending on the sensor measurement values.

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6. Method according to Claim 5 characterised in that

the pre-washing process is prematurely discontinued in the second program structure only in the case of a small degree of opaqueness during pre-washing and a change of water for the following program step is inhibited, whereas the amount of water is varied in the case of increased opaqueness.

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7. Method according to Claim 6, characterised in that

in the case of a curtailed pre-washing process, the time saved is added to the subsequent program steps.

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EUROPEAN SEARCH REPORT

Application Number
EP 99 11 3042

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 888 269 A (BASHARK) 10 June 1975 (1975-06-10) * column 2, line 34 - column 3, line 68 * * column 5, line 9 - column 10, line 56 * ---	1-3,5-7	A47L15/46
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A47L D06F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
MUNICH		11 November 1999	Laue, F
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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11-11-1999

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