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(54) **Process for operating a dishwasher and dishwasher operated according to such process**

(57) In a process for operating a dishwasher, comprising:

(A) at least one cleaning step during which a warmed washing liquid containing a cleaning agent is circulated within the dishwasher;

(B) at least one rinsing step during which a warmed washing liquid containing a rinse aid is circulated within the dishwasher; and

C) a drying step during which the circulation of the wash-

ing liquid is terminated and the washing liquid is drained from the dishwasher;

it is suggested that:

- during the rinsing step directly preceding step (C) the washing liquid is warmed to only such a degree that foaming of the rinse aid is avoided; and

- during step (C) no heating energy is supplied to the dishwasher.

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Description

[0001] The present invention relates to a process for operating a dishwasher, in which at least one cleaning step is carried out during which a warmed washing liquid containing a cleaning agent is circulated within the dishwasher, at least one rinsing step is carried out during which a warmed washing liquid containing a rinse aid is circulated within the dishwasher, and a drying step is carried out during which the circulation of the washing liquid is terminated and the washing liquid is drained from the dish washer.

[0002] In such processes as they are carried out in dishwashers the user usually can select amongst several program variants in order to adapt the respective washing program to the articles to be washed as well as to the degree of soiling of such articles, be it dishes, pots, pans, silverware etc. By selecting the relevant washing program the program variables such as, for example, the duration of the individual program steps, the amount of water supplied into the dishwasher, the amount of cleaning agent added, the temperatures to be reached in the individual steps as well as the number of the individual washing steps are varied. Thus it for example is usual to provide for so called "intensive programs" for heavily soiled dishes in which programs several cleaning steps are applied, for example, a pre-cleaning step and a main cleaning step and/or in which several rinsing steps are used, wherein the duration and temperatures of the individual steps may vary.

[0003] Common to all these processes is that for drying the dishes at the end of the washing program the dishes are heated during a hot rinsing step to a temperature of, for example, 60°C or more so that the dishes after terminating the circulation of the washing liquid dries by evaporation using the heat that has accumulated in the dishes during the hot rinse step. It was also suggested for drying the dishes to provide for additional heating devices which supply additional heat to the dishes during the drying step.

[0004] Thus, for example, DE 199 34 121 A1 describes a washing process for dishwashers of the type mentioned above, in which during a rinsing step preceding the drying step fresh water is introduced into the washing tub and is heated until a temperature of 60°C is reached in the interior of the tub. In the drying step the circulation of the washing liquid is terminated and the washing liquid is drained from the dishwasher. Furthermore, when in the drying step the temperature in the washing tub has reached 60 °C and a delay of 5 to 10 minutes has lapsed, a motor driven fan is started to withdraw from the interior of the dishwasher any vapour that has formed during the drying of the dishes.

[0005] A similar process is disclosed in DE 24 04 988 A1, according to which for drying the dishes the interior of the dishwasher is heated to a temperature of 55 to 70 °C, wherein during the drying step additionally a certain quantity of fresh air is passed through the interior of the

washing tub.

[0006] Processes to operate a dishwasher in which during the drying step no additional heat has to be supplied to the dishes are also known from WO 99/23932 and CH 602 202, since in the processes suggested in these documents the dishes, for the purpose of disinfection, anyway previously are heated to temperatures of 85°C and more.

[0007] Finally, in DE 103 56 786 A1 a process for operating a dishwasher is described, in which for drying the cleaned dishes the wet air is accumulated within the dishwasher is withdrawn from the interior of the dishwasher and is transported to a separate sorption container, in which the wet air is brought into contact with and adsorbent so as to remove the humidity therefrom. Such a process does not only require a complicated and complex construction but also has a high energy demand because already in the normal operation the sorption container has to be heated to a temperature of 140 °C and for the desorption thereof even has to be heated to temperatures of 200 to 300 °C.

[0008] It is the object of the present invention to provide for a process of operating a dishwasher which is more advantageous in terms of energy consumption than the known processes and which nevertheless provides for an acceptable drying of the dishes.

[0009] In a process for operating a dishwasher comprising the steps:

- (A) at least one cleaning step during which a warmed washing liquid containing a cleaning agent is circulated within the dishwasher;
- (B) at least one rinsing step during which a warmed washing liquid containing a rinse aid is circulated within the dishwasher and
- (C) a drying step during which the circulation of the washing liquid is terminated and the washing liquid is drained from the dishwasher,

the above object is solved in that in accordance with the present invention during the rinsing step directly preceding step (C) the washing liquid is warmed to only such a degree that foaming of the rinse aid is avoided; and during step (C) no heating energy is supplied to the dishwasher.

[0010] By warming the washing liquid during the said rinsing step to only a temperature at which no foaming of the rinse aid is to be expected, which temperature generally is in the range of from 30 to 50 °C and preferably is between 40 and 45 °C, the energy consumption of the dishwasher is considerably lowered, while at the same time by lowering the temperature the distribution of the rinse aid over the articles which are arranged within the dishwasher is considerably improved, so that the dripping-off of the washing liquid from the articles is improved and shorter drying times are achieved.

[0011] The present invention thus takes advantage of the fact that most users of dishwashers do not immediately unload the dishwasher after termination of the

washing program, so that in most cases a considerable amount of time elapses between the end of the program and the time when the machine is unloaded, which time thus can be advantageously used to dry the articles by the natural drying effect. Although by lowering the temperature to which the cleaned articles are heated during the rinsing step, less energy is available for evaporation of humidity that still adheres to the articles, such decrease in energy input at least in part is compensated because less energy is needed for the drying, since by effectively avoiding foaming of the rinse aid, the present process provides for better distribution of the rinse aid and hence for better removal of the washing liquid from the articles by the dripping effect, thus leaving less liquid on the articles that needs to be evaporated to achieve complete drying of the cleaned articles.

[0012] In addition to saving energy the method of the present invention also provides for substantially shorter washing cycles, so that the articles to be washed are available for reuse after shorter time periods, although in cases where the dishwasher is unloaded immediately after termination of the washing program some moisture might remain on the articles, so that for complete drying of the cleaned goods it might be necessary to additionally dry the cleaned articles by hand.

[0013] Tests performed by the applicant have shown that using the method of the present invention the usual washing cycles can be shortened by up to 30 % and that energy savings of up to 25 % can be achieved while maintaining the same cleaning performance as it is provided for by known processes.

[0014] Preferred embodiments of the invention are defined in the dependent claims.

[0015] In particular, as already noted above, the temperature to which the washing liquid is warmed during the last rinsing step preceding the drying step can be in the range of from 30 to 50 °C, preferably of from 40 to 45 °C, which is considerably lower than the temperatures used in the hot rinse step of the known processes.

[0016] The rinse aid which is distributed during the rinsing step over the articles to be washed, so as to promote removal of any washing liquid from the articles during the subsequent drying step, maybe added either during one of the rinsing steps or may be made available by adding to the washing liquid already during step (A) a multi-component agent containing at least a cleaning agent and a rinse aid and by taking precautions that dissolution of the rinse aid is prolonged or carried over into the rinsing step.

[0017] Such multi-component agents or combined agents usually contain at least a cleaning agent and a rinse aid (2in1 agent), but additionally may contain an agent acting on the salt content of the washing liquid so as to adapt the water hardness (3in1 agent), optionally additionally a glass protecting agent (4in1 agent), and optionally additionally containing an agent to improve shining of the stainless steel tub of the dishwasher (5in1 agent). Usually such multi-component agents are provided as tabs that are placed into the respective washing

agent compartment of the dishwasher before starting the wash program. Thus although the various substances contained in the multi-component agent is added to the washing liquid already at the beginning of the washing program, the individual agents are released into the washing liquid with a different timing. Basically this can be provided for either by so-called carry-over or by encapsulating, sometimes called encysting, of those agents which are to be released later in the washing cycle.

[0018] In embodiments using carry-over those agents that shall be used at a later point in time such as the rinse aid, are provided at higher concentrations in the multi-component tab, so that due to adhesion of such agent on the articles to be cleaned and/or on the interior walls of the dishwasher, still a sufficiently high concentration of such agent is contained in the washing liquid when needed so as to achieve the intended effect. It should be understood that the term "carry-over" does not mean that there is no dissolution of the respective agent in preceding program steps, but rather that there still is dissolution of the respective agent, i.e. of for example the rinse aid, in the intended program step, such as the rinsing step.

[0019] In embodiments using encysting, those substances that shall be used at a later point in time, such as the rinse aid, are encapsulated within the tab, for example, by using a wax capsule, which does not dissolve until a certain stage in the program is reached. Decomposition of the capsule can be provided, for example, in dependency of pH-value or of temperature.

[0020] The rinsing step can be either a single rinsing step or a sequence of individual rinsing steps, wherein during the first rinsing step(s) no rinse aid is added to the washing liquid, which rinse aid is added to the washing liquid only in the last rinsing step

[0021] A plurality of rinsing steps can be of particular advantage if heavy soiled articles are to be cleaned. Such plural rinsing steps may comprise, for example, a first rinsing step with cold water to which no rinse aid is added, and a subsequent rinsing step with water having a temperature of between 30 and 50 °C, preferably of between 40 and 45 °C, to which a rinse aid is added.

[0022] Upon adding the rinse aid to the washing liquid the circulation of the washing liquid through the dishwasher should be continued for a sufficient time to guarantee that the rinse aid is distributed over the articles that are arranged within the dishwasher.

[0023] Preferably the process is implemented such that during the rinsing step the washing liquid first is heated to the desired temperature, for example, 45 °C, and then is circulated throughout the dishwasher until the desired temperature is reached within the dishwasher, i.e. until the articles that are arranged within the dishwasher have been brought to the desired temperature, which temperature can be measured within the dishwasher by temperature probes. In a further portion of the rinsing step a predetermined amount of rinse aid is added to the washing liquid, which washing liquid containing the rinse aid then is circulated through the dishwasher for a dura-

tion of 1 to 15 minutes, preferably of from 5 to 10 minutes, so as to homogeneously distribute the rinse aid over the articles arranged within the dishwasher.

[0024] Preferably, during the drying step within 15 to 90 seconds after termination of the circulation of the washing liquid, i.e. after allowing a short time for the washing liquid to drip-off from the articles to be cleaned and to accumulate within the sump of the dishwasher, the washing liquid is drained from the dishwasher by activating the drain pump.

[0025] After expiry of a dripping and drying time of 1 to 10 minutes, preferably of 4 to 6 minutes, after terminating the circulation of the washing liquid, the drying step is terminated, i.e. the washing program is ended, the end of the program is indicated to the user and the door of the dishwasher is unlocked so that the dishwasher can be unloaded.

[0026] Alternatively after expiry of the said dripping and drying time the drain pump may again be activated so as to empty the sump of the dishwasher by draining the washing liquid that has dripped off from the cleaned articles and has accumulated in the dishwasher sump.

[0027] The present invention also relates to a dishwasher comprising a control arrangement that is adapted to conduct the process described above. While the dishwasher can be adapted to always be operated using the said process, preferably the dishwasher comprises a selector arrangement, by which a user can select the said process, or a different process, such as washing cycles as they are implemented in known dishwashers.

[0028] By using the process described herein cycle times are substantially shortened. Thus, the present process takes advantage of the behaviour of many users of dishwashers, who either do not immediately unload the dishwasher after termination of the program, but rather leave the dishwasher operating unattended, for example, over night or also during daytime, when users start the dishwasher in the morning before leaving to work and unload the dishwasher not until returning home after work in the late afternoon or evening. On the other hand, consumers, who want to reuse their cleaned dishes very fast, for example, when there is a party where many dishes are needed, it is important that the dishes are cleaned fast and it can be accepted that they are not completely dry at the end of the program. The present process thus enables the customer to shorten the washing program and to thereby save energy, wherein nevertheless sufficient drying is ensured by distributing a rinse aid over the articles to be washed and heating the washing fluid only to such a temperature that foaming of the rinse aid, which would be detrimental to the distribution of the rinse aid, is avoided.

Claims

1. Process for operating a dishwasher, comprising the following steps:

(A) at least one cleaning step during which a warmed washing liquid containing a cleaning agent is circulated within the dishwasher;
(B) at least one rinsing step during which a warmed washing liquid containing a rinse aid is circulated within the dishwasher; and
(C) a drying step during which the circulation of the washing liquid is terminated and the washing liquid is drained from the dishwasher;

characterized in that:

- during the rinsing step directly preceding step (C) the washing liquid is warmed to only such a degree that foaming of the rinse aid is avoided; and
- during step (C) no heating energy is supplied to the dishwasher.

2. The process of claim 1, in which a rinse aid is added to the washing liquid during step (B).
3. The process of claim 1, in which addition of a rinse aid is effected already during step (A), but dissolution of the rinse aid is carried over into step (B).
4. The process of claim 1, in which addition of a rinse aid is effected by adding during step (A) a multi-component agent to the washing liquid which multi-component agent contains at least a cleaning agent and a rinse aid.
5. The process of claim 1, in which the multi-component agent that is added to the washing liquid during step (A) additionally contains an agent for adjusting the hardness of the washing liquid, a glass protecting agent and/or a stainless steel shining agent.
6. The process of claim 1, in which during step (B) first at least one rinsing step without addition of a rinse aid is performed and subsequently at least one further rinsing step is performed during which a rinse aid is added to the washing liquid.
7. The process as defined in any one of the preceding claims, in which during the rinsing step directly preceding step (C) the washing liquid is warmed to a temperature of between 30 and 50 °C, preferably of between 40 and 45 °C.
8. The process as defined in any one of the preceding claims, in which during step (B) the washing liquid is circulated within the dishwasher for a period that is sufficient to distribute the rinse aid over the articles that are arranged within the dishwasher.
9. The process of claim 1, in which during step (B), upon having reached the temperature to be attained, the washing liquid is circulated through the dish-

washer for a duration of from 1 to 15 min.

- 10.** The process as defined in any one of the preceding claims, in which during step (C) within 15 to 90 s after terminating the circulation of the washing liquid the washing liquid is drained from the dishwasher. 5
- 11.** The process as defined in any one of the preceding claims, in which step (C) is terminated after expiry of a dripping time of 1 to 10 min, preferably of 4 to 6 min, after terminating the circulation of the washing liquid. 10
- 12.** The process of claim 1, in which during step (C) after expiry of a dripping time of 1 to 10 min, preferably of 4 to 6 min, after terminating the circulation of the washing liquid the washing liquid which has accumulated within the dishwasher is drained. 15
- 13.** Dishwasher comprising a control arrangement adapted to conduct the process as defined in any one of the preceding claims. 20
- 14.** The dishwasher of claim 13, comprising a selector arrangement by which a user can select a process as defined in any one of claims 1 to 12. 25

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EUROPEAN SEARCH REPORT

Application Number
EP 08 00 0930

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Place of search Munich		Date of completion of the search 21 May 2008	Examiner Hannam, Martin
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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.
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