



(11) **EP 1 567 289 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
23.05.2007 Bulletin 2007/21

(51) Int Cl.:
B08B 3/04 (2006.01) A47L 15/00 (2006.01)
C11D 3/00 (2006.01) C11D 7/00 (2006.01)

(21) Application number: **03772309.5**

(86) International application number:
PCT/EP2003/012366

(22) Date of filing: **06.11.2003**

(87) International publication number:
WO 2004/052564 (24.06.2004 Gazette 2004/26)

(54) **ACIDIC CLEANING METHOD FOR MACHINE DISHWASHING**

SÄUREREINIGUNGSVERFAHREN FÜR GESCHIRRSPÜLEN IN DER MASCHINE

PROCEDE DE NETTOYAGE ACIDE POUR LAVAGE DE VAISSELLE EN MACHINE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

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(30) Priority: **06.12.2002 DE 10257391**

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(43) Date of publication of application:
31.08.2005 Bulletin 2005/35

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EP 1 567 289 B1

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Description

5 [0001] This invention relates to a machine dishwashing process for cleaning tableware or other surfaces soiled with food remains. More particularly, the object of the invention is to improve the continuous or discontinuous process of machine dishwashing which may be carried out both in single-tank and in multi-tank machines.

10 [0002] In conventional dishwashing processes, food-soiled tableware, including, for example, trays, cutlery and glasses smeared with lipstick residues, is sprayed or squirted with water in a prewash zone or prewash cycle, i.e. before the actual washing process. This water is cold or preheated fresh water, cooling water from a vapor condensation process, but generally overflow water of a wash liquor which is generally sprayed under low pressure through relatively large spray arm openings on to the tableware. After this prewash zone or prewash cycle, the tableware enters the actual wash zone or wash cycle where it is sprayed with wash liquor.

15 [0003] The wash liquor usually consists of water with a temperature of about 50°C to 65°C to which a cleaner is added. In order to remove grease, starch, dyes and protein with sufficient reliability, detergents in powder or liquid form, for example, are added to the water, so that about 0.1 to 0.3% by weight of active washing substances are present in the cleaning solution. The resulting wash liquor is usually sprayed on to the articles to be cleaned through differently arranged nozzles. The soil on the tableware is thus removed or at least swollen or softened and partially dissolved. In a following clear-wash zone or clear-wash cycle, the soaked or softened soil and food remains are removed with water. At the same time, the wash liquor is rinsed off. In the following rinse cycle, the rinse water usually consists of fresh water and a rinse agent, which generally ensures that only a very thin film of water is left on the tableware and can drain off or evaporate in following drying zones.

20 [0004] The requirements which institutional and domestic dishwashing machine are expected to satisfy are different. Depending on the particular type and the application involved, institutional dishwashing machines usually comprise several tanks arranged in succession, from which rinse and wash liquor is sprayed onto the tableware to be cleaned as it passes through the machine. The tanks are generally arranged on the cascade principle, the rinse and wash liquor passing successively through the tanks from the outlet end to the inlet end of the tableware. Fresh water is generally fed into the machines at the outlet end. The required amount of detergent is dosed into at least one wash tank also known as the dosing tank. The dosing of detergent normally takes place automatically depending on the conductivity or the pH of the wash liquor or optionally by means of a dosing pump controlled by a timer or clock. Several components may also be separately dosed. For example a basic lye solution based on an aqueous alkali metal hydroxide solution

25 [0005] As explained in EP 282 214, a problem which often occurred in the past was that, in regular conventional cleaning, periodic thorough cleaning steps could not be completely dispensed with, even when relatively large amounts of detergents were used. The purpose of this thorough cleaning is to remove coatings of, in particular, water-insoluble starch which have built up over time, but which are not immediately visible to the eye. During this thorough cleaning, the articles, preferably the tableware, are occasionally treated with wash liquor containing several times the usual concentration of active substances. This causes considerable pollution of the wastewater. As already stated, EP 282 214 tackled this problem. An attempt was made by improving cleaning performance to reduce labor, the consumption of water and chemicals and hence environmental pollution and, at the same time, to achieve satisfactory cleaning. EP 282 214 attempts to solve the problem by spraying a highly concentrated cleaning formulation onto the soiled articles, followed by a contact phase, after which the cleaning solution and soil are removed in one or more following steps.

30 [0006] As explained, EP 282 214 mentions reducing pollution of the wastewater as an essential aim of the invention. However, on closer examination of the process as a whole, it becomes clear that an essential aspect of the pollution of wastewater was not taken into account. In the treatment of wastewater, it is usually imperative for the wastewater to have a certain pH before or during treatment in corresponding treatment plants. This pH is generally close to the neutral point of water according to the nature of the treatment. Depending on legislation, there are even country-specific wastewater regulations which stipulate a particular pH for wastewater. All this means is that more chemicals have to added to neutralize strongly acidic or strongly alkaline wastewater before further treatment. In other words, whilst the chemicals saved in the cleaning process according to EP 282 214 no longer pollute the wastewater, more chemicals still have to be used at a later stage to neutralize the wastewater flowing off before the water treatment. EP 282 214 takes no account at all of this problem. On the contrary, throughout the disclosure of EP 282 214 only alkaline detergents are mentioned and recommended. In column 3, line 15 onwards, the cleaning agents to be used are explicitly discussed. In particular, from column 3, line 24, it is disclosed that, for example, alternately spraying with high alkalinity and then with lower alkalinity could have advantages. It is then explained that a further advantage of the system is that chemicals which are usually incompatible, for example oxidizing agents, such as hypochlorite, with water treatment substances, such as NTA

for example, can be used alongside one another in the process. Further down in column 3, line 42 onwards, it is stated that various substances are known to improve penetration and to help soften and remove the soil. In addition, EP 282 214 A1 states that a basic formulation will typically contain an alkalinity source and a sequestrant source. On the bases of formulations such as these, it is possible to cater for special problems such as, for example, tea stains or other residues which may be found on tableware. After reading these passages from EP 282 214, and also after reading the following Example in column 4, line 3 onwards, the expert would inevitably conclude that it is normal to carry out processes of this kind with alkaline compositions - all the more so as it used to be the standard procedure. As explained, however, the problem arises in practice that the wastewaters produced have a high pH because of the high levels of alkalinity attributable - depending on the process - to large quantities of alkaline cleaning solutions and/or to high concentrations of alkaline detergent substances. Accordingly, it is also necessary (and indeed often even stipulated in wastewater regulations), particularly when following the teaching of EP 282 214, for the alkalinity used for the cleaning process to be neutralized with acids to a certain pH either before or during treatment of the wastewater.

[0007] WO 02/31095 A1 describes a detergent composition and a method for warewashing in which an acidic rinse is used in a mechanical dishwashing process to obtain a better soil release effect. According to WO 02/31095 A1 an acidic component is dosed into the post-wash rinse zone or the post-wash rinse step. Example 1 of the WO 02/31095 A1 describes a pre-treatment of ceramic dishes with an acidic rinse product. After this process the dishes were rinsed and soiled. A disadvantage of this process is that a pre-treatment of the ceramic dishes is necessary which makes the whole cleaning process more complex.

[0008] Accordingly, the problem addressed by the present invention was to provide a process which, firstly, would solve the cleaning problem posed by EP 282 214 without the need for thorough cleaning. Secondly and as a limitation with respect to EP 282 214, the problem addressed by the invention was to minimize the time and effort involved in neutralization before or during treatment in wastewater treatment plants. At the same time, care would be taken where possible to ensure that applicational requirements with regard to equipment and other factors would be satisfied.

[0009] The present invention relates to a process for continuous or discontinuous machine dishwashing, in which the tableware is treated at least in one process step with an acidic cleaning solution and, in another process step, with an alkaline cleaning solution, comprising the steps of

- a) applying an acidic aqueous cleaning solution before the final rinse cycle or the final rinse zone to the at least partly soiled tableware and
- b) removing said acidic aqueous cleaning solution and the soil in one or more following steps,

the at least one alkaline treatment taking place before and/or after the acidic treatment and the alkaline and at least one acidic aqueous cleaning solution at least partially neutralizing one another.

[0010] In the process according to the invention, the acidic cleaning solution mentioned contains one or more acids selected from the mineral and/or organic acids. In a particularly preferred embodiment, at least one acid is present which is selected from sulfuric acid, nitric acid, phosphoric acid, formic acid, acetic acid, propanoic acid, glycolic acid, citric acid, maleic acid, lactic acid, gluconic acid, alkanesulfonic acid, amidosulfonic acid, succinic acid, glutaric acid, adipic acid, phosphonic acids, polyacrylic acids or mixtures thereof and, in a most particularly embodiment, from formic acid, glycolic acid, gluconic acid, amidosulfonic acid or the alkanesulfonic acids, more particularly methanesulfonic acid or mixtures thereof.

[0011] The aqueous acidic cleaning solution to be sprayed on in accordance with the invention preferably contains as further components a corrosion inhibitor and/or a typical complexing agent which, in a particularly preferred embodiment, is selected from the phosphonic acids, more particularly dioctyl phosphonic acid.

[0012] In another preferred embodiment of the process according to the present invention, the acidic cleaning solution contains between 0.01 and 10% by weight of one or more detergent substances, based on the cleaning solution. In a particularly preferred embodiment, the acidic cleaning solution mentioned contains less than 0.9% by weight, more particularly less than 0.8% by weight and, in a most particularly preferred embodiment, less than 0.5% by weight of one or more detergent substances, based on the cleaning solution.

[0013] The exact conditions also depend on the more precise practical circumstances and the performance requirements the process is expected to meet. For example, if there is a risk of corrosion where the acid concentration in the acidic cleaning solution is too high through plant-specific circumstances in practice, then it is advisable to use weakly acidic cleaning solutions with an active acid content of less than 0.9% by weight, preferably less than 0.8% by weight and more particularly less than 0.5% by weight. Depending on machine parameters, weakly acidic cleaning solutions may also have the advantage that the consumption of the lye baths into which the possibly acidic solution is carried over is not too high.

[0014] Apart from the performance-related requirements, when the process is considered as a whole, this procedure also leads to a reduction in pollution of the wastewater, in contrast to EP 282 214, because of the partial neutralization. As a result, less effort is involved before further treatment of the wastewater.

[0015] In another preferred embodiment of the process according to the invention, the acidic aqueous cleaning solution is allowed to act on the tableware and the soil for a certain contact time (during which spraying stops), the contact time preferably being 2 to 100 seconds, more preferably 5 to 100 seconds and most preferably 8 to 25 seconds. In another preferred embodiment, the tableware is not intentionally sprayed during the contact time.

[0016] In another preferred embodiment, the acidic aqueous cleaning solution is sprayed onto the tableware as a fine, gentle mist-like liquid spray.

[0017] In another preferred embodiment of the process according to the invention, the acidic cleaning solution is applied to the tableware as foam.

[0018] It is pointed out at this juncture that other forms of application may also be considered and that the success of the method does not depend on the form of application alone. For example, the cleaning solution could also be applied to the tableware in droplet form or by the Ecolab process known commercially as thin film cleaning (TFC).

[0019] Depending on the form of application, appropriate nozzles or alternative aids are preferably used.

[0020] Another preferred embodiment of the process according to the invention is characterized in that the treatment with the acidic cleaning solution is preceded by an alkaline treatment of the tableware of which the pH is a particularly preferred embodiment is above 10. In another preferred embodiment, the treatment with the acidic cleaning solution is followed by an alkaline treatment of the tableware. In a most particularly preferred embodiment, however, the tableware is subjected in all to at least three cleaning steps, the treatment with the acidic cleaning solution being preceded and followed by an alkaline treatment of the tableware.

[0021] It should be further explained that, where least two alkaline steps occur in the process according to the invention, the alkaline step taking place earlier in the process sequence - in a particularly preferred embodiment - has a lower pH than the alkaline step taking place later in the process sequence. This is advantageous in order to minimize consumption in an acidic step taking place between the two alkaline steps mentioned.

[0022] In a preferred embodiment of the alkaline treatment mentioned in the process according to the invention, the tableware comes into contact with one or more aqueous cleaning solutions containing between 0.1 and 4% by weight of an alkali carrier, preferably a hydroxide selected from sodium hydroxide, potassium hydroxide or mixtures thereof.

[0023] Other preferred alkali carriers - in addition to or instead of hydroxides selected from sodium and potassium hydroxide - include, for example, alkali metal silicates, ethanolamines, such as triethanolamine, diethanolamine and monoethanolamine, and also alkali metal carbonates of an alkali carrier, preferably a hydroxide selected from sodium or potassium hydroxide. Other alkali carriers may of course also be used because it is principally a matter of increasing the pH.

[0024] It is also described an institutional dishwashing machine comprising several tanks which are arranged adjacent one another in known manner on the cascade principle and from which rinse or wash liquor is sprayed onto the tableware and then drains back into the tanks, the tanks intended for one or more acidic cleaning steps in the operation of the process according to the invention being made of acid-resistant material and/or lined with acid-resistant material.

[0025] In addition, it is described a single-tank washing machine, for example a domestic dishwasher, which can be used in a process according to the invention and which is made of and/or lined with acid-resistant material, more particularly in the places where it comes in to contact with acidic cleaning solutions.

[0026] The process of the invention has the further advantage that mineralic deposits on glass and dishes, like lime deposits, which are soluble in acidic solution are removed.

Example 1:

Cleaning of dinner plates in a Krefft® single-tank dishwashing machine

[0027] For each test, 10 new, dry dinner plates were soiled with starch at room temperature by a standardized test method. To this end, a ca. 6% aqueous composition containing corn starch was cooled to 75°C after boiling and was applied to each plate with a brush in a quantity of ca. 4 ml. The plates thus treated were left to stand for at least 3 hours and then dried at ca. 100°C for 16 hours. After the plates had cooled, comparison tests were carried out in a Krefft® single-tank dishwashing machine according to the following scheme:

- a) Cleaning for 1 minute with a 0.3% by weight aqueous solution of a standard alkaline detergent which remains constant (ca. 17% by weight alkali metal hydroxide, 14% by weight tripolyphosphate and 1.5% by weight alkali metal hypochlorite and ca. 1% by weight alkali silicate and the remainder water).
- b) Whole-surface spraying of the plates area using different kinds of spray-on solutions - of which the composition is described in more detail in Table 1 - for the various tests.
- c) Allowing the spray-on solution applied to act for 30 seconds.
- d) Cleaning for 2 minutes with a solution according to a).

EP 1 567 289 B1

[0028] The cleaning solutions and spray-on solutions were prepared with softened water. The cleaning temperature in the Krefft® single-tank dishwashing machine was 60°C.

[0029] 6 tests were first carried out to the described scheme, the composition of cleaning solutions a) and d) being maintained and only the spray-on solution being varied from test to test.

[0030] Cleaning was evaluated by scoring on a scale of 1 (= no visible sign of cleaning) to 10 (= complete removal of soil).

[0031] The results of the 6 tests are set out in Table 1.

Table 1:

Cleaning results in tests to the described scheme, only the spray-on solution being varied from test to test.		
Test	Spray-on solution	Evaluation of cleaning performance
1 (comparative)	1% NaOH	4.6
2 (comparative)	0.3 g/l Perzym (= enzyme-containing product)	1.2
3	0.4% methanesulfonic acid	9.0
4	0.7% by weight methanesulfonic acid	9.5
5	1 % by weight methanesulfonic acid	9.5
6 (comparative)	Water	1.2

[0032] As can be seen from Table 1, by far the best cleaning results were achieved in tests 3 to 5 where a solution of methanesulfonic acid was used as the spray-on solution. Accordingly, the cleaning principle in this very advantageous case consisted in cleaning first with alkaline solution, then with acidic solution and, after that, with alkaline solution again.

[0033] Further investigations showed that similar results could also be obtained with other acids. Particularly emphasis is placed in this regard on the organic acids: formic acid, glycolic acid, gluconic acid, amidosulfonic acid or other alkanesulfonic acids, more particularly with an alkane chain of 1 to 4 C atoms.

[0034] As can be seen from this simple test arrangement, it is possible by alternating the pH to achieve excellent cleaning results in practice, even with acid concentrations of less than 0.5% by weight of active acid. It is also clear that, by using lower acid concentrations, there is a reduction in the undesirable partial neutralization in the cleaning process, for example because of residues of cleaning solution adhering to the tableware which are treated in the next step with a cleaning solution of opposite pH.

Example 2:

Test in a conveyor dishwasher machine Meiko GSM

[0035] The following test was made in a conveyor dishwasher machine Meiko GSM®. The tests were carried out with soiled dishes from a canteen. The conditions in the Meiko GSM dishwashing machine were as follows: As cleaner Perclin® Intensiv Flüssig (1,5 g/l; 3,2 mS/cm) was used. In the machine softened water in an amount of 500 l/h was used. The acid content was 1,4 to 1,5% phosphoric acid. The machine had a built in spraying system with a spraying amount of 36 l/h and a pressure of 4 bar.

[0036] Table 2 shows the cleaning results dependant from the different pH-values in the different bars.

Table 2

Time	pH-Value			Cleaning Result
	Bath 1	Bath 2	Bath 3	
Start	10,7	10,6	10,7	6
10	10,2	10,4	10,6	6
20	9,8	10,3	10,5	5,5
30	9,7	10,2	10,4	5,5
40	9,6	9,9	10,3	3,5
50	9,5	9,5	10,3	2

EP 1 567 289 B1

(continued)

Time	pH-Value			Cleaning Result
	Bath 1	Bath 2	Bath 3	
60	9,4	9,5	10,3	-

[0037] In the further tests, a dripping plate was installed in the bars with a spraying system to prevent that acid is running into the alkaline wash tanks. Furthermore, the concentration of the acid was reduced to 1 % phosphoric acids. All other parameters were not changed. The results are shown in table 3.

Table 3

Time	pH-Value			Cleaning Result
	Tank 1	Tank 2	Tank 3	
Start (without acid)	10,5	10,5	10,6	0,5
Start (with acid)	10,5	10,5	10,6	9
10 min	10,5	10,5	10,6	9
20 min	10,4	10,4	10,7	7
30 min	10,1	10,4	10,5	3,5
40 min	10,0	10,4	10,4	4
50 min	10,4	10,4	10,8	5,5
60 min	10,0	10,3	10,5	5
70 min	10,2	10,5	10,8	5
90 min	9,9	10,2	10,4	6
120 min	9,8	10,3	10,4	5,5
120 min (without acid)	9,8	10,3	10,4	0

[0038] From table 2 and 3 can be seen that a very good cleaning result is only achieved if the pH-value of the first step is at minimum 10 or higher. The cleaning performance with the acid step is always higher than without the acid step. This can be seen at the beginning and at the end of the test. Furthermore, it can be seen that a higher concentration of the phosphoric acid causes a better cleaning performance.

Example 3:

pH-relation between the first and third tank of Meiko GSM

[0039] To find the best pH-relation from the first and the third tank for the Meiko GSM, a test with two Krefft® single-tank dishwasher was performed. In the first machine a pH was adjusted with NaOH, a second pH was adjusted in the second Krefft® dishwashing machine. The water was softened with pH of 9,8 and the temperature was 60° C in both machines. The first step was one minute cleaning followed by a spraying step with a 1 % phosphoric acid and a contact time of 30 seconds and an additional cleaning step of two minutes. Results are shown in the following table 4.

Table 4

pH Krefft 1	pH Krefft 2	Cleaning Result
9,8	12	8
12	9,8	6
11	12	10
12	11	7

EP 1 567 289 B1

(continued)

pH Krefft 1	pH Krefft 2	Cleaning Result
11	11	6,5

[0040] From the table can be seen that it seems to be the best to start with a pH-value of about 11 and the acid step and follow then with an alkaline step which is higher in alkalinity than the first one.

Claims

1. A process for continuous or discontinuous machine dishwashing, in which the tableware is treated at least in one process step with an acidic cleaning solution and, in another process step, with an alkaline cleaning solution, comprising the steps of
 - a) applying an acidic aqueous cleaning solution before the final rinse cycle or the final rinse zone to the at least partly soiled tableware and
 - b) removing the acidic aqueous cleaning solution and the soil in one or more following steps,the at least one alkaline treatment taking place before and/or after the acidic treatment and the alkaline and at least one acidic aqueous cleaning solution at least partially neutralizing one another.
2. A process as claimed in claim 1, **characterized in that** the acidic aqueous cleaning solution contains one or more acids selected from the mineral and/or organic acids.
3. A process as claimed in claim 2, **characterized in that** at least one acid is present which is selected from sulfuric acid, nitric acid, phosphoric acid, formic acid, acetic acid, propanoic acid, glycolic acid, citric acid, maleic acid, lactic acid, gluconic acid, alkane sulfonic acid, amidosulfonic acid, succinic acid, glutaric acid, adipic acid, oxalic acid, benzoic acid, phosphonic acids, polyacrylic acids or mixtures thereof.
4. A process as claimed in claim 3, **characterized in that** at least one acid is present which is selected from formic acid, glycolic acid, gluconic acid, amidosulfonic acid or the alkanesulfonic acids, more particularly methanesulfonic acid or mixtures thereof.
5. A process as claimed in one or more of claims 1 to 4, **characterized in that** the acidic aqueous cleaning solution contains between 0.01 and 10% by weight of one or more deterative substances, based on the cleaning solution.
6. A process as claimed in claim 5, **characterized in that** the acidic aqueous cleaning solution contains less than 0.9% by weight, preferably less than 0.8% by weight and more preferably less than 0.5% by weight of one or more deterative substances, based on the cleaning solution.
7. A process as claimed in one or more of claims 1 to 6, **characterized in that** the acidic aqueous cleaning solution is allowed to act on to the tableware and the soil for a certain contact time (during which spraying stops), the contact time of this aqueous cleaning solution with the tableware preferably being 2 to 100 seconds, more preferably 5 to 100 seconds and most preferably 8 to 25 seconds.
8. A process as claimed in claim 7, **characterized in that** the tableware is not intentionally sprayed during the contact time.
9. A process as claimed in claims 1 to 8, **characterized in that** the acidic aqueous cleaning solution is sprayed onto the tableware as a fine, gentle, mist-like liquid spray.
10. A process as claimed in one or more of claims 1 to 8, **characterized in that** the acidic aqueous cleaning solution is applied to the tableware as foam.
11. A process as claimed in claim 9 or 10, **characterized in that** the acidic aqueous cleaning solution is applied through suitable nozzles.

12. A process as claimed in one or more of claims 1 to 11, **characterized in that** the treatment with the acidic aqueous cleaning solution is preceded by an alkaline treatment.
- 5 13. A process as claimed in claim 12, **characterized in that** an aqueous cleaning solution having a pH above 10 is used for the alkaline treatment of the tableware.
14. A process as claimed in one or more of claims 1 to 13, **characterized in that** the treatment with the acidic aqueous cleaning solution is followed by an alkaline treatment of the tableware.
- 10 15. A process as claimed in one or more of claims 12 to 14, **characterized in that** the tableware is subjected in all to at least three cleaning steps, an alkaline treatment of the tableware being carried out before and after the treatment with the acidic aqueous cleaning solution.
- 15 16. A process as claimed in one or more of claims 12 to 15, **characterized in that**, during the alkaline treatment, the tableware is contacted with one or more aqueous cleaning solutions which contain between 0.1 and 4% by weight of an alkali carrier, preferably a hydroxide selected from sodium hydroxide, potassium hydroxide or mixtures thereof.
- 20 17. A process as claimed in one or more of claims 1 to 16, **characterized in that** the pH of the wastewater produced by the process is below 12, preferably below 11.

Patentansprüche

- 25 1. Verfahren zum kontinuierlichen oder diskontinuierlichen maschinellen Geschirrspülen, wobei das Tafelgeschirr in wenigstens einem Verfahrensschritt mit einer sauren Reinigungslösung und in einem weiteren Verfahrensschritt mit einer alkalischen Reinigungslösung behandelt wird, umfassend die Schritte
- 30 a) Aufbringen einer sauren wässrigen Reinigungslösung vor dem letzten Spülgang oder der letzten Spülzone auf das zumindest teilweise verschmutzte Tafelgeschirr und
b) Entfernen der sauren wässrigen Reinigungslösung und des Schmutzes in einem oder mehreren folgenden Schritten,
- wobei die wenigstens eine alkalische Behandlung vor und/oder nach der sauren Behandlung erfolgt und die alkalische und die wenigstens eine saure wässrige Reinigungslösung sich zumindest teilweise gegenseitig neutralisieren.
- 35 2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung eine oder mehrere Säuren enthält, die ausgewählt sind aus Mineralsäuren und/oder organischen Säuren.
- 40 3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** wenigstens eine Säure vorhanden ist, die ausgewählt ist aus Schwefelsäure, Salpetersäure, Phosphorsäure, Ameisensäure, Essigsäure, Propionsäure, Glycolsäure, Citronensäure, Maleinsäure, Milchsäure, Gluconsäure, Alkansulfonsäure, Amidosulfonsäure, Bernsteinsäure, Glutarsäure, Adipinsäure, Oxalsäure, Benzoesäure, Phosphonsäuren, Polyacrylsäuren oder Mischungen derselben
- 45 4. Verfahren nach Anspruch 3, **dadurch gekennzeichnet, dass** wenigstens eine Säure vorhanden ist, die ausgewählt ist aus Ameisensäure, Glycolsäure, Gluconsäure, Amidosulfonsäure oder Alkansulfonsäuren, insbesondere Methansulfonsäure oder Mischungen derselben.
- 50 5. Verfahren nach einem oder mehreren der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung zwischen 0,01 und 10 Gew.-%, bezogen auf die Reinigungslösung, einer oder mehrerer reinigungsaktiver Substanzen enthält.
- 55 6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung weniger als 0,9 Gew.-%, vorzugsweise weniger als 0,8 Gew.-% und besonders bevorzugt weniger als 0,5 Gew.-%, bezogen auf die Reinigungslösung, einer oder mehrerer reinigungsaktiver Substanzen enthält.
7. Verfahren nach einem oder mehreren der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** man die saure wässrige Reinigungslösung über eine bestimmte Kontaktzeit (während der das Sprühen eingestellt wird) auf das Tafelgeschirr und den Schmutz einwirken lässt, wobei die Kontaktzeit dieser wässrigen Reinigungslösung mit dem

EP 1 567 289 B1

Tafelgeschirr vorzugsweise 2 bis 100 Sekunden, mehr bevorzugt 5 bis 100 Sekunden und besonders bevorzugt 8 bis 25 Sekunden beträgt.

- 5 8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** das Tafelgeschirr während der Kontaktzeit nicht absichtlich besprüht wird.
9. Verfahren nach den Ansprüchen 1 bis 8, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung in Form eines feinen, leichten, dunstartigen flüssigen Sprühnebels auf das Tafelgeschirr aufgesprüht wird.
- 10 10. Verfahren nach einem oder mehreren der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung in Form eines Schaums auf das Tafelgeschirr aufgebracht wird.
11. Verfahren nach Anspruch 9 oder 10, **dadurch gekennzeichnet, dass** die saure wässrige Reinigungslösung durch geeignete Düsen aufgebracht wird.
- 15 12. Verfahren nach einem oder mehreren der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** vor der Behandlung mit der sauren wässrigen Reinigungslösung eine alkalische Behandlung erfolgt.
- 20 13. Verfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** eine wässrige Reinigungslösung mit einem pH von über 10 für die alkalische Behandlung des Tafelgeschirrs eingesetzt wird.
14. Verfahren nach einem oder mehreren der Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** auf die Behandlung mit der sauren wässrigen Reinigungslösung eine alkalische Behandlung des Tafelgeschirrs folgt.
- 25 15. Verfahren nach einem oder mehreren der Ansprüche 12 bis 14, **dadurch gekennzeichnet, dass** das Tafelgeschirr insgesamt wenigstens drei Reinigungsschritten unterzogen wird, wobei vor und nach der Behandlung mit der sauren wässrigen Reinigungslösung eine alkalische Behandlung des Tafelgeschirrs erfolgt.
- 30 16. Verfahren nach einem oder mehreren der Ansprüche 12 bis 15, **dadurch gekennzeichnet, dass** das Tafelgeschirr bei der alkalischen Behandlung mit einer oder mehreren wässrigen Reinigungslösungen in Kontakt gebracht wird, die zwischen 0,1 und 4 Gew.-% eines Alkaliträgers enthalten, vorzugsweise eines Hydroxids, das ausgewählt ist aus Natriumhydroxid, Kaliumhydroxid oder Mischungen derselben.
- 35 17. Verfahren nach einem oder mehreren der Ansprüche 1 bis 16, **dadurch gekennzeichnet, dass** der pH des bei dem Verfahren anfallenden Abwassers unter 12, vorzugsweise unter 11 liegt.

Revendications

- 40 1. Procédé pour le lavage de la vaisselle en machine, en continu ou en discontinu, dans lequel la vaisselle est traitée au moins dans une étape de traitement avec une solution nettoyante acide et, dans une autre étape de traitement, avec une solution nettoyante alcaline, comprenant les étapes suivantes :
- 45 a) appliquer une solution nettoyante aqueuse acide avant le cycle de rinçage final ou la zone de rinçage final à la vaisselle au moins partiellement salie et
b) éliminer la solution nettoyante aqueuse acide et les saletés dans une ou plusieurs étapes suivantes,
- l'au moins un traitement alcalin ayant lieu avant et/ou après le traitement acide et la solution alcaline et l'au moins une solution nettoyante aqueuse acide se neutralisant l'une l'autre au moins partiellement.
- 50 2. Procédé selon la revendication 1, **caractérisé en ce que** la solution nettoyante aqueuse acide contient un ou plusieurs acides choisis parmi les acides minéraux et/ou organiques.
- 55 3. Procédé selon la revendication 2, **caractérisé en ce qu'**au moins un acide est présent, lequel est choisi parmi l'acide sulfurique, l'acide nitrique, l'acide phosphorique, l'acide formique, l'acide acétique, l'acide propanoïque, l'acide glycolique, l'acide citrique, l'acide maléique, l'acide lactique, l'acide gluconique, un acide alcanesulfonique, l'acide amidosulfonique, l'acide succinique, l'acide glutarique, l'acide adipique, l'acide oxalique, l'acide benzoïque, les acides phosphoniques, les acides polyacryliques et leurs mélanges.

EP 1 567 289 B1

4. Procédé selon la revendication 3, **caractérisé en ce qu'**au moins un acide est présent, lequel est choisi parmi l'acide formique, l'acide glycolique, l'acide gluconique, l'acide amidosulfonique et les acides alcanesulfoniques, plus particulièrement l'acide méthanesulfonique ou ses mélanges.
- 5 5. Procédé selon une ou plusieurs des revendications 1 à 4, **caractérisé en ce que** la solution nettoyante aqueuse acide contient entre 0,01 et 10 % en poids d'une ou plusieurs substances détersives, sur la base de la solution nettoyante.
- 10 6. Procédé selon la revendication 5, **caractérisé en ce que** la solution nettoyante aqueuse acide contient moins de 0,9% en poids, de préférence moins de 0,8 % en poids et plus particulièrement moins de 0,5 % en poids d'une ou plusieurs substances détersives, sur la base de la solution nettoyante.
- 15 7. Procédé selon une ou plusieurs des revendications 1 à 6, **caractérisé en ce que** la solution nettoyante aqueuse acide est laissée à agir sur la vaisselle et les saletés pendant un certain temps de contact (durant lequel l'aspersion est stoppée), le temps de contact de cette solution nettoyante aqueuse avec la vaisselle étant de préférence de 2 à 100 secondes, mieux encore de 5 à 100 secondes et tout spécialement de 8 à 25 secondes.
- 20 8. Procédé selon la revendication 7, **caractérisé en ce que** la vaisselle n'est pas aspergée intentionnellement durant le temps de contact.
- 25 9. Procédé selon les revendications 1 à 8, **caractérisé en ce que** la solution nettoyante aqueuse acide est aspergée sur la vaisselle sous la forme d'une pulvérisation fine et légère de liquide, analogue à une brume.
- 30 10. Procédé selon une ou plusieurs des revendications 1 à 8, **caractérisé en ce que** la solution nettoyante aqueuse acide est appliquée à la vaisselle sous la forme d'une mousse.
- 35 11. Procédé selon la revendication 9 ou 10, **caractérisé en ce que** la solution nettoyante aqueuse acide est appliquée par l'intermédiaire de buses adaptées.
- 40 12. Procédé selon une ou plusieurs des revendications 1 à 11, **caractérisé en ce que** le traitement avec la solution nettoyante aqueuse acide est précédé d'un traitement alcalin.
- 45 13. Procédé selon la revendication 12, **caractérisé en ce qu'**une solution nettoyante aqueuse ayant un pH supérieur à 10 est utilisée pour le traitement alcalin de la vaisselle.
- 50 14. Procédé selon une ou plusieurs des revendications 1 à 13, **caractérisé en ce que** le traitement avec la solution nettoyante aqueuse acide est suivi d'un traitement alcalin de la vaisselle.
- 55 15. Procédé selon une ou plusieurs des revendications 12 à 14, **caractérisé en ce que** la vaisselle subit en tout au moins trois étapes de nettoyage, un traitement alcalin de la vaisselle étant effectué avant et après le traitement avec la solution nettoyante aqueuse acide.
16. Procédé selon une ou plusieurs des revendications 12 à 15, **caractérisé en ce que**, durant le traitement alcalin, la vaisselle est mise en contact avec une ou plusieurs solutions nettoyantes aqueuses qui contiennent entre 0,1 et 4 % en poids d'un support alcalin, de préférence un hydroxyde choisi parmi l'hydroxyde de sodium, l'hydroxyde de potassium et leurs mélanges.
17. Procédé selon une ou plusieurs des revendications 1 à 16, **caractérisé en ce que** le pH des eaux usées produites par le procédé est inférieur à 12, de préférence inférieur à 11.