



- (51) **International Patent Classification:** Not classified
- (21) **International Application Number:**
PCT/EP2011/056809
- (22) **International Filing Date:**
29 April 2011 (29.04.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (71) **Applicant** (for all designated States except US): **ECOLAB USA INC.** [—/US]; 370 Wabasha Street N, St. Paul, Minnesota 55102-1390 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants** (for US only): **WINTER, Johannes Georg** [DE/DE]; Münchner Straße 89, 82008 Unterhaching (DE). **BEISEMANN, Peter Bruno** [DE/DE]; Haus Gravenor Straße 70, 40764 Langenfeld (DE).
- (74) **Agents:** **POLYPATENT** et al.; An den Gärten 7, 51491 Overath (DE).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))



WO 2012/146296 A2

(54) **Title:** METHOD FOR REDUCING THE VOLUME OF FOAM BY COOLING MEANS

(57) **Abstract:** The present invention refers to a method for reducing the volume of foam derived from wash liquid or from a detergent composition, characterized in that the foam is subjected to cooling.

Method for reducing the volume of foam by cooling means

The present invention refers to a method for reducing the volume of foam derived from wash liquid or from a detergent composition.

5

When an aqueous medium, for example a wash liquid, is agitated and if applicable heated, the contents of the aqueous medium such as surfactants are responsible for foaming. The invention relates to the control of such foaming of wash liquids. More particularly, the invention relates to the control of the total
10 volume of foam derived from wash liquids after the foam has been developed or built up.

In many applications, the generation of substantial quantity of foam can be merely an annoyance. However, in certain applications, the foam can prevent proper
15 operation of equipment or can be harmful to the apparatus containing the wash liquid. Should a substantial volume of foam be drawn into lines leading to a pump or other mechanical device, the foam can cavitate or otherwise prevent the proper flow of liquid through the line, the pump or other device. A pump exposed only to foam can become overheated and can be damaged or destroyed. Accordingly, for
20 the purpose of this application, the accumulation of a substantial volume of foam relates to the production of sufficient foam that is either unwanted, undesirable or unsightly or is an amount such that if the foam enters an apparatus associated with the wash liquid, the foam could prevent proper operation including inappropriate or incomplete cleaning, spills of foam out of the apparatus onto
25 closeby surfaces leaving undesirable residue or microbial growth sites or harm working parts of the apparatus. Industrial washing systems are equipped with sensors in order to detect undesired accumulation of laundry articles at critical locations. Foam may also activate such sensors and stop the whole process.

30 Especially the use of detergent compositions in an industrial washing process, like in a tunnel washer, causes foam being build up after the washing step when the laundry articles leave the tunnel and are pressed to reduce the water content in the laundry articles. After that, the laundry articles leave the machine on a conveyer belt equipped with sensors which may be activated also by foam. If the

detector is activated by foam, the conveyer belts stop and the whole process in the tunnel washer is interrupted. Undesired foaming may also occur in overflow or storage tanks associated with the tunnel washer, which tanks serve as receptacle for wash liquid, rinse liquid or other. As the tunnel washing is a continuous
5 process, this means that the whole process stops and has to be started again by manual operation. The stopping of the continuous batch washer, however, reduces the daily throughput and thereby its profitability.

The foaming of wash liquids depends on many factors e.g. hardness of the water,
10 the chemical behaviour of the surfactant contained in the cleaning or detergent compositions, the nature and the amount of soiling of the laundry articles to be cleaned etc.

The control of the generation of foam from aqueous media during processing has
15 been a continuing problem for many years. A number of chemical classes of active defoaming materials have been proposed for use in defoaming aqueous systems containing a variety of foaming materials. Such defoamers have been more or less effective depending on the concentration of foaming materials, the temperature of the aqueous media, the geometry of pumps, tanks or lines, the
20 degree of mixing or agitation, and the mode of addition of an effective defoaming concentration of the defoaming composition. Control of the concentration of a defoaming composition in the aqueous medium is not always easily accomplished.

25 Further, the usual de-foamers like fatty alcohols or paraffines or silicon oil do not avoid the foaming of the composition in a sufficient way. Further, it is not possible to predict in which situation an undesirable strong foaming occurs. In addition, it is not possible either to increase the amount of de-foamer because this too does not prevent the composition from foaming. Further, detergent compositions already
30 contain a considerable high amount of de-foamer and thereby increases its price.

Summary of the invention

The object of the present invention therefore was to provide a reliable means to reduce the volume of foam.

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The technical objection is solved by a method for reducing the volume of foam derived from wash liquid or from a detergent composition, characterized in that the foam is subjected to cooling.

10 In a preferred method cooling means are applied in order to cool the foam.

In a further preferred method of the present invention the wash liquid is used for washing laundry articles. The term "foam derived from wash liquid" used herein also includes foam which occurs when laundry articles are pressed or centrifuged
15 in order to remove wash liquid or rinse liquid (such as water). The term "foam derived from wash liquid" also includes foam which is derived from a detergent composition, which is used to prepare a wash liquid for the wet treatment of laundry articles. The detergent compositions cause foam formation not only in respect to the handling of the wash liquid itself and during the washing process as
20 such (either freshly prepared wash liquid, recycled wash liquid or used wash liquid) but may also trigger foam formation during the handling of rinse liquid, press liquid or liquid drained from the centrifuge, which liquids still contain traces of surfactants derived from the wash liquid and from the detergent composition, respectively.

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The term "laundry articles" used herein refers to woven laundry articles as well as to non-woven laundry articles, including clothing, textiles, mattresses, carpets, mops, towels and bed sheets. Exemplary articles of clothing or garments laundered at an industrial laundering facility include robes, uniform shirts, uniform
30 pants, executive shirts, lab coats, aprons, jackets, and shop coats. The reference to textiles includes items or articles that include textiles or fabric. Items or articles that include textiles or fabric can include athletic shoes, accessories, stuffed animals, brushes, mats, hats, gloves, outerwear, tarpaulins, tents, and curtains.

The term "detergent composition" used herein refers to a composition comprising all ingredients for producing a wash liquid, including one or more surfactants. The term "detergent composition" used herein also refers to modular detergent compositions which comprises separately at least a basis detergent and a
5 surfactant booster.

The method of the present invention is particularly useful in connection with industrial laundry where continuous batch washers or wash extractors are used. Especially the use of detergent composition in an industrial washing process, like
10 in a tunnel washer, causes foaming during washing or after the washing step when the laundry articles leave the tunnel and are pressed to reduce their water content or in case wash liquid is transferred to overflow or storage containers, for example for temporary storage. Sensors are activated by foam and stop further processing of the laundry articles and/or the whole process in the tunnel washer.
15 As mentioned, undesired foam may occur in overflow or storage tanks associated with the tunnel washer, which tanks serve as receptacle for wash liquid, rinse liquid, press liquid, liquid drained from a centrifuge or any other liquid to be used for or which result from the wet treatment of laundry articles. With the method according to the present invention means are provided to counteract undesired
20 foaming and problems caused by undesired foaming. The method according to the present invention helps to maintain the throughput of continuous batch washers or wash extractors by reducing or avoiding interruption of the washing process. Therefore, the method of the present invention increases profitability of the continuous washing process. A further advantage is that detergent
25 compositions for washing laundry articles may be provided having a lower content of de-foamer.

In a particularly preferred embodiment the method is applied in connection with the operation of continuous batch washers or wash extractors.

30

According to the method of the present invention for reducing the volume of foam wherein the foam is subjected to cooling, i.e. the foam is subjected to a decrease of temperature, the temperature of the wash liquid shall not or shall substantially not be altered or decreased.

Foam is mostly considered to be a problem introduced by foaming surfactants which are part of the detergent composition. Foam consists of gas surrounded by a thin layer of a water/surfactant mixture. The gas contained in the foam however,
5 follows all physicochemical laws any gas follows. As for gases the equation $p \cdot V/T$ is a constant (p = pressure, V = gas volume, T = gas temperature) any reduction in temperature results in a lower gas volume at constant pressure. Foam subjected to cooling results in a decrease in volume of the foam bubble. With other words the cooling results in a decrease of gas pressure inside the gas bubble compared
10 to the ambient atmospheric pressure which in turn increase the force the bubble film layer experiences from the environment outside the bubble which in turn also leads to reduction of bubble size.

As mentioned above, according to the present invention the temperature of the
15 gas or vapour enclosed within the foam bubbles is decreased.

The decrease of the temperature of the gas or vapour enclosed within the foam bubble is preferably carried out in that the temperature of the environment surrounding the foam is decreased by at least 10 °C, further preferred by at least
20 15°C, still further preferred by at least 20°C and most preferred by at least 25°C. The term "environment" surrounding the foam herein means the air or any solid material, such as container walls of receiver tanks, overflow areas or slides on which the laundry articles are moving which may come into direct contact with foam.

25

The term "environment" does not include the wash liquid as such. However, in a particularly preferred method of the present invention the term "environment" includes the water/foam interface which cooling results in a very effective foam reduction. Therefore, in a preferred method the cooling of the foam is carried out
30 by the addition of solid objects which float on the surface of the wash liquid and have a temperature of 10°C or less, preferably 5°C or less, further preferred 0°C or less, more preferred -5°C or less, further more preferred -20°C or less and most preferred -50°C or less.

In a further preferred method the cooling of the foam is carried out by the addition of ice particles, such as crushed (water) ice. As used herein the term "ice" means frozen water.

- 5 In another particularly preferred method, the cooling of the foam is carried out by the addition of solid carbon dioxide (dry ice). As used herein the term "dry ice" means carbon dioxide snow or compressed carbon dioxide snow or carbon dioxide pellets, which is compressed carbon dioxide snow. When adding dry ice to an aqueous solution, such as a wash liquid, the dry ice, although having a higher
10 density than water, swims or floats on the water surface and provides a cooling effect to the ambient air next to the water surface. This floating and cooling effect of the dry ice can be used to selectively cool the interface of water with foam resulting in a cooling of the foam and a strong reduction of the volume of foam at almost no reduction of the water temperature. The same effect can be obtained
15 when using ice cubes or crushed ice made from water.

When using water ice for cooling the foam water ice may be used in pure or homogenous form or in non homogenous impure form as a composition having at least 20 wt.-% of the total composition solid water ice in the form of blocks,
20 pellets, ice cubes or snow in any geometrical shape.

When using solid carbon dioxide for cooling foam solid carbon dioxide may be used in pure form or as impure dry ice as a composition having at least 20 wt.-% of the total composition solid carbon dioxide in the form of blocks pellets or snow.

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In a particularly preferred method said solid objects, said ice particles (water ice) and said solid carbon dioxide (dry ice) are added to the wash liquid in order to reduce the volume of foam. Said wash liquid may be either freshly prepared wash liquid, recycled wash liquid or used wash liquid. Further, said solid objects, said
30 ice particles (water ice) and said solid carbon dioxide (dry ice) may be added to any liquid which develops foam derived from a detergent composition in order to reduce the volume of foam, such as wash liquid, wash liquid to be used, used wash liquid, wash liquid which may be re-used, as well as rinse liquid, press liquid and liquid drained from a centrifuge rinse liquid.

In a further preferred embodiment of the method the cooling of the foam is carried out by decreasing the temperature of components of the equipment used for the wet treatment of laundry articles, with which equipment components the foam comes into contact.

According to the method of the present invention for reducing the volume of foam wherein cooling is applied to the foam, i.e. the foam is subjected to a decrease of temperature, the temperature of the wash liquid shall not or shall substantially not be decreased. This means that the decrease in temperature of the wash liquid when carrying out the method of the present invention for reducing foam is 2 °C or less, preferably 1 °C or less, most preferred no decrease.

The person skilled in the art understands that in particular in situations where foam accumulates in areas where the wash liquid is not present or is not present anymore the application of cooling to the foam does have no effect on the wash liquid. Such a situation is where the foam is not in direct contact with the wash liquid any more or where the foam is not floating on the wash liquid, for example when the laundry articles are pressed in order to remove the wash liquid therefrom.

In order to achieve a temperature decrease of the foam or the gas within the foam bubbles, preferably the temperature of the ambient air surrounding the foam is decreased by at least 10 °C, further preferred by at least 15°C, still further preferred by at least 20°C and most preferred by at least 25°C.

In a further preferred method the temperature of the ambient air surrounding the foam is decreased to a temperature which is at least 10 °C lower than the temperature of the wash liquid, further preferred at least 15°C, still further preferred at least 20°C and most preferred at least 25°C lower than the temperature of the wash liquid.

In a further preferred embodiment of the method of the present invention the cooling of the foam is carried out by treatment of the foam with a cold gaseous

medium. As cold gaseous medium cold air may be used. The term "cold" does not limit the scope to a particularly cold temperature; instead the term "cold" refers to a temperature of the air sufficient to decrease the temperature of the foam or the gas within the foam bubbles in order to reduce the volume of the bubbles. For example the temperature of the cold air which is used to reduce the foam volume may be 20°C or lower, preferably 15°C or lower, further preferred 10°C or lower. The cold gaseous medium such as cold air is blown at the foam using a fan or blower.

- 10 In an alternative embodiment cooling the foam is carried out by decreasing the temperature of solid objects with which the foam is in contact. For example, foam may not only rest on top of the wash liquid but may flow out of the container containing the wash liquid. Further, foam may occur when laundry articles are pressed in order to remove the wash liquid from the laundry articles. In such cases foam may be located within a tub or basin or may be located on metal parts or metal sheet parts, such as a slide, which may be cooled in order to reduce the volume of the foam. A slide, for example, connects the continuous batch washer with the press, and laundry articles are transferred after the washing and rinsing step to the press via the slide. In a further embodiment, a grid may be arranged on top of or above an overflow vessel containing a foaming liquid such as wash liquid, rinse liquid, press liquid or liquid drained from a centrifuge. The grid may be cooled in order to cool the foam, resulting in reducing the volume of the foam.

- In a particularly preferred method those surfactants initially contained in the wash liquid, when added in an amount of 0.1 weight % in an aqueous solution give a foam height of at least 10 cm, preferably at least 15 cm and more preferred at least 20 cm as measured in the Ross Miles Foam Test. The Ross Miles Test is well known in the art as a means for determining both foam formation and foam stability (ASTM D-1173 (D-1173-53, D-1173-07) DIN53902). Thus a 0.1 weight % solution of the surfactants contained in the wash liquid preferably retains at least about 50%, preferably at least 60%, more preferably at least 70%, even more preferred at least 80% and most preferred at least 90% of initial foam height after 15 minutes as measured in the Ross Miles Foam Test.

- In a further preferred method the detergent composition used to prepare said wash liquid, when added in an amount of 0.1 weight % to an aqueous solution give a foam height of at least 5 cm, preferably at least 10 cm and more preferred at least 15 cm as measured in the Ross Miles Foam Test. Thus a 0.1 weight %
5 solution of the detergent composition used to prepare said wash liquid preferably retains at least about 50%, preferably at least 60%, more preferably at least 70%, even more preferred at least 80% and most preferred at least 90% of initial foam height after 15 minutes as measured in the Ross Miles Foam Test.
- 10 As the invention provides an efficient means to control and reduce foam which has been formed, detergent compositions as a whole and surfactants responsible for foaming, respectively, now may be chosen for preparing the wash liquid, which may have comparably stronger foaming properties. The invention therefore gives the possibility to select suitable detergent compositions and surfactants,
15 respectively, for preparing wash liquid, in respect to criteria such as washing efficiency, regardless of their foaming properties. This means that the skilled person is not restricted any more to detergent compositions and surfactants, respectively, having low or medium foaming properties.
- 20 In a still further preferred embodiment of the method of the present invention the detergent composition used to prepare said wash liquid contains less than 20 weight %, preferably less than 15 weight %, further preferred less than 10 weight %, still further preferred less than 5 weight %, even further preferred less than 2 weight %, even more preferred less than 1 weight % and most preferred no de-
25 foamer. As the invention provides an efficient means to control and reduce foam which has been formed, detergent compositions now may be used for preparing the wash liquid, which have a lower content of de-foamer or which may not contain any de-foamer.
- 30 The present invention also provides a method for the wet treatment of laundry articles comprising the steps of washing, rinsing and drainage, wherein the wet treatment is carried out in a washing system, wherein during the washing step a detergent composition is used in the wash liquid, wherein foam which is formed

during the operation of the washing system is reduced by subjecting the foam to cooling.

In a preferred embodiment the wet treatment of laundry articles is carried out in a washing system comprising a tunnel washer. In another preferred embodiment
5 the wet treatment of laundry articles is carried out in a washing system comprising a wash extractor. At the end of the washing system a drainage device such as a centrifuge or press for removing the liquid in the laundry is provided.

10 In a further embodiment the foam is formed during drainage of the laundry articles. Undesired foaming often occurs when the laundry articles are washed but also when the laundry articles are pressed or centrifuged in order to remove the liquid contained therein. While the liquid is collected and discarded, or introduced into a tank or fed back to the washing system the foam stays at the location where
15 it has been formed and poses a problem. The present invention therefore provides means to reduce the undesired foaming at such a location. According to the present invention this undesired foam is reduced by cooling the foam.

Further, the foam may also be formed during the handling of the wash liquid. Such
20 handling of the wash liquid includes the washing step in the strictest sense, namely the treatment of the laundry with wash liquid. Further, the handling of the wash liquid particularly includes also the transfer of the wash liquid to and from any compartment of the washing system. For example, the handling of the wash liquid includes its transfer to and from overflow or storage tanks which are
25 associated with the continuous batch washer or wash extractor. Such tanks may for example serve as receptacle for excess wash liquid, wash liquid to be used, used wash liquid, wash liquid which may be re-used, as well as rinse liquid, press liquid and liquid drained from a centrifuge. Undesired foaming may occur in such overflow or storage tanks particularly at the locations where the inlet of the wash
30 liquid is arranged. The present invention therefore provides means to reduce the undesired foaming at these locations.

Therefore, as used herein the term "the foam formed during the handling of the wash liquid" includes any operation which results in moving, transporting or

- agitating wash liquid, wash liquid to be used, used wash liquid, wash liquid which may be re-used, as well as rinse liquid, press liquid and liquid drained from a centrifuge. The term "the foam formed during the handling of the wash liquid" also includes foam which is derived from a detergent composition, which is used to
- 5 prepare a wash liquid for the wet treatment of laundry articles. Therefore, the detergent composition may be the cause for foam formation not only in respect to the handling of the wash liquid itself but also cause foam formation during the handling of rinse liquid, press liquid or liquid drained from the centrifuge.
- 10 In preferred embodiments of the method for washing laundry articles any preferred feature in respect to the above described method for reducing the volume of foam derived from wash liquid or from a detergent composition, characterized in that foam is subjected to cooling may be also applied.
- 15 In a further preferred method of the present invention the wash liquid is used for washing laundry articles. As pointed out above, the detergent compositions cause foam formation not only in respect to the handling of the wash liquid itself but may also trigger foam formation during the handling of rinse liquid, press liquid or liquid drained from the centrifuge, which liquids still contain traces of surfactants derived
- 20 from the wash liquid and from the detergent composition, respectively.

In a particularly preferred embodiment the method is applied in connection with the operation of continuous batch washers or wash extractors. Undesired foam may occur in overflow or storage tanks associated with the tunnel washer, which

25 tanks serve as receptacle for wash liquid, rinse liquid, press liquid, liquid drained from a centrifuge or any other liquid to be used for or which result from the wet treatment of laundry articles. The method according to the present invention means are provided to counteract undesired foaming and problems caused by undesired foaming.

30

According to the invention the volume of foam is reduced by cooling the foam, i.e. the foam is subjected to a decrease of temperature. In particular, the temperature of the gas or vapour enclosed within the foam bubbles is decreased. However, the temperature of the wash liquid shall not or shall substantially not be decreased.

The decrease of the temperature of the gas or vapour enclosed within the foam bubble is preferably carried out in that the temperature of the environment surrounding the foam is decreased by at least 10 °C, further preferred by at least 15°C, still further preferred by at least 20°C and most preferred by at least 25°C. The term "environment" surrounding the foam herein means the air or any solid material which may come into direct contact with foam, as well as the water/foam interface. The term "environment" does not include the (whole) wash liquid as such. According to the method of the present invention the foam is subjected to a decrease of temperature, whereas the temperature of the wash liquid shall not or shall substantially not be altered. This means that the decrease in temperature of the wash liquid when carrying out the method of the present invention for reducing foam is 2 °C or less, preferably 1 °C or less, most preferred no decrease.

In order to achieve a temperature decrease of the foam or the gas within the foam bubbles, preferably the temperature of the ambient air surrounding the foam is decreased by at least 10 °C, further preferred by at least 15°C, still further preferred by at least 20°C and most preferred by at least 25°C.

In a further preferred method the temperature of the ambient air surrounding the foam is decreased to a temperature which is at least 10 °C lower than the temperature of the wash liquid, further preferred at least 15°C, still further preferred at least 20°C and most preferred at least 25°C lower than the temperature of the wash liquid.

25

In a further preferred embodiment of the method of the present invention the cooling of the foam is carried out by treatment of the foam with a cold gaseous medium. As cold gaseous medium cold air may be used. The temperature of the air is sufficient to decrease the temperature of the foam or the gas within the foam bubbles in order to reduce bubble size. For example the temperature of the cold air which is used to reduce the foam volume may be 20°C or lower, preferably 15°C or lower, further preferred 10°C or lower. The cold gaseous medium such as cold air is blown at the foam using a fan or blower.

In areas where the installation of devices for cooling air is not applicable due to spatial problems the foam may be cooled by use of other devices. In a further preferred embodiment of the method the cooling of the foam is carried out by decreasing the temperature of components of the equipment used for the wet treatment of laundry articles, with which equipment components the foam is in contact.

In a particularly preferred method those surfactants initially contained in the wash liquid, when added in an amount of 0.1 weight % in an aqueous solution give a foam height of at least 10 cm, preferably at least 15 cm and more preferred at least 20 cm as measured in the Ross Miles Foam Test. A 0.1 weight % solution of the surfactants contained in the wash liquid preferably retains at least about 50%, preferably at least 60%, more preferably at least 70%, even more preferred at least 80% and most preferred at least 90% of initial foam height after 15 minutes as measured in the Ross Miles Foam Test.

In a further preferred method the detergent composition used to prepare said wash liquid, when added in an amount of 0.1 weight % to an aqueous solution give a foam height of at least 5 cm, preferably at least 10 cm and more preferred at least 15 cm as measured in the Ross Miles Foam Test. A 0.1 weight % solution of the detergent composition used to prepare said wash liquid preferably retains at least about 50%, preferably at least 60%, more preferably at least 70%, even more preferred at least 80% and most preferred at least 90% of initial foam height after 15 minutes as measured in the Ross Miles Foam Test.

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The invention provides an efficient means to control and reduce foam which has been formed. Therefore, one may select detergent compositions and surfactants, respectively, which have stronger foaming properties than those used before.

In one embodiment of the method of the present invention for the wet treatment of laundry articles comprising the steps of washing, rinsing and drainage, a (all-in-one) detergent composition in form of a mixture is used to prepare wash liquid. In an alternative embodiment of the method a modular detergent composition is

used to prepare wash liquid. A modular detergent composition comprises separately a basis detergent and a surfactant booster.

In a still further preferred embodiment of the method of the present invention the
5 detergent composition used to prepare said wash liquid contains less than 20
weight %, preferably less than 15 weight %, further preferred less than 10 weight
%, still further preferred less than 5 weight %, even further preferred less than 2
weight %, even more preferred less than 1 weight % and most preferred no de-
foamer. As the invention provides an efficient means to control and reduce foam
10 which has been formed, detergent compositions now may be used for preparing
the wash liquid, which have a lower content of de-foamer or which may not
contain any de-foamer.

Detailed description of the invention

15

As mentioned above the present invention provides a method for reducing the
volume of foam derived from wash liquid or from a detergent composition,
characterized in that the foam is subjected to cooling. Further, the present
invention provides a method for the wet treatment of laundry articles comprising
20 the steps of washing, rinsing and drainage, wherein the wet treatment is carried
out in a washing system, wherein during the washing step a detergent
composition is used in the wash liquid, wherein foam which is formed during the
operation of the washing system is reduced by subjecting the foam to cooling.

25 The methods of the present invention are particularly useful in connection with
industrial laundry where continuous batch washers or wash extractors are used.
Especially the use of detergent composition in an industrial washing process, like
in a tunnel washer, causes foaming during washing or particularly after the
washing step when the laundry items leave the tunnel and are pressed or
30 centrifuged to reduce the water content in the laundry article.

A continuous batch washer generally comprises a cylindrical drum or an interior
drum that can be rotated about its longitudinal axis by means of driving means,
i.e., in one of the two possible driving directions. Located inside the drum is a

worm or a screw which, e.g., may consist of canted sheet metal and whose exterior helical exterior edge is joined, in particular welded, to the interior wall of the drum. In so doing, the screw has helical cants or reinforcement ribs and that extend in radial direction. The arrangement of the rotatably supported drum, including the screw that is located therein and non-rotationally connected to the drum corresponds to the arrangement of a screw-tube conveyor.

Continuous batch washers operate based on a pivoting or rotating washing principle. The laundry transport is accomplished along the generated surface of the drum or through the center of the drum. Continuous batch washers are equipped with a drum which comprise, in longitudinal direction, washing chambers, which are arranged adjacent to and separate from each other and through which laundry items to be washed can be conveyed in longitudinal direction of the drum. The washing chambers which are separated from each other are configured to represent an Archimedean screw. The Archimedean screw is connected, along its exterior edge to the drum. The drum can be driven so as to rotate about its longitudinal axis in two opposing directions of rotation, whereby a first direction of rotation corresponds to a washing mode and the second direction of rotation corresponds to a conveying mode.

20

The washing regions located next to each other in longitudinal direction of the drum are configured as washing chambers defined by discoidal dividing walls, said dividing walls being arranged in the drum perpendicular to the longitudinal axis of the drum and their exterior edges being welded to the drum. In order to pass laundry items from one washing chamber into the adjacent washing chamber, central circular openings are provided in the dividing walls, each of said openings being provided upstream with a blade-like structure that also comprises a metal dividing baffle.

When the drum is in washing mode, the laundry items are lifted by means of a metal entrainment baffle or dividing baffle and are subsequently allowed to drop from above into the treatment fluid during each rotation of the drum. When the direction of rotation of the drum is reversed for the purpose of conveying the laundry items into the next washing chamber, the laundry and at least a part of the

treatment fluid are moved by means of the blade-like structure to the opening in the dividing wall and from there-viewed in conveying direction-to the adjacent washing chamber.

- 5 In other known tunnel washers the Archimedean screw or worm is arranged in the drum that can be selectively rotated in one or the other direction, said screw or worm being non-rotationally connected to the drum and being connected in a fluid-tight manner to the inside of the drum along said drum's exterior edge. The setup of this arrangement basically corresponds to that of a screw-tube conveyor.
- 10 Respectively one washing chamber is defined between two adjacent cants of a screw, thus corresponding to a washing chamber of the aforementioned prior art. In order to convey the laundry items from one washing chamber to the other washing chamber, the drum, along with the screw, is rotated by 360° , whereby, consistent with the known mode of operation of a screw-tube conveyor, the items
- 15 of laundry lying in the treatment fluid, along with the treatment fluid, are advanced in conveying direction by a distance corresponding to the width of one washing chamber. During the washing cycle, the drum, including the screw, is intermittently moved in one and in the other direction, i.e., back and forth, and the required washing mechanics are thus generated.

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- In washing mode, a continuous batch washer may advantageously be selectively operated either in a rotating or also in a back-and-forth pivoting manner. In conveying mode of a continuous batch washer the laundry is transported by means of the screw in conveying direction. Basically, the treatment fluid may take
- 25 the same path.

- A feeding hopper, for example, is used for loading the laundry items to be treated into the drum and the treated laundry items are moved out of the continuous batch washer, for example, by means of an output slide; and, subsequently, said
- 30 laundry items are passed on to a water-extracting device. Such water-extracting device or drainage device may be a centrifuge or in particular a water-extracting press. In conveying mode, the laundry items are transported through the drum in the general conveying direction by rotation of the drum, including the screw, in the opposite direction of rotation.

The methods of the present invention, wherein the volume of foam is reduced by cooling the foam, are particularly suitable for processes and situations, where the foam which has been formed comes to rest, i.e. which is stagnant or stationary.

5 Such stationary foam e.g. occurs if the washing mode of a continuous batch washer is set to a back-and-forth pivoting manner of the Archimedean screw, as compared to a rotating manner wherein the foam is continuously agitated and mixed with the wash liquid.

10 Therefore, in a preferred embodiment of the present methods for reducing the volume of foam, the foam to be subjected to cooling is stationary foam. The foam may exist as foam flooding/floating on top of wash liquid, or in the area of the water-extracting press. In particular, foaming may occur after the washing step when the laundry articles leave the tunnel and are pressed or centrifuged to
15 reduce the water content in the laundry article. Undesired foaming may also occur in overflow or storage tanks which are associated with the tunnel washer. Such overflow or storage tanks are used to take up excess wash liquid or wash liquid used for exchange or wash liquid for intermediate storage.

20 The method of the present invention provides means to help fighting against undesired foam which has been formed without necessity to add separate de-foamer or without need to use a different detergent composition with increased content of de-foamer. A particular advantage is that foam can be removed independently of the chemistry used in the wash liquid and independently of the
25 water quality and independently of the nature or amount of soiling of the laundry articles to be cleaned. A further advantage is that also those surfactants may be chosen in detergent composition for preparing wash liquid which have stronger or strong foaming properties.

30 The present invention also provides a washing system for wet treatment of laundry articles comprising a continuous batch washer (tunnel washer) and a drainage system, wherein the washing system is provided with cooling means. In a preferred embodiment of the washing system the cooling means are arranged in the area of the water-extracting device and/or in the area of one or more inlet

- which pass wash liquid to overflow or storage tanks; wherein the wash liquid preferably is drained from the washing chamber to the overflow or storage tanks. As water-extracting device a centrifuge or water-extracting press is preferred. A water-extracting press is particularly preferred, which removes wash liquid or
- 5 water from the laundry articles. In an alternative embodiment of the washing system cooling means are provided, adapted for direct cooling air, which air is located within a compartment of the washing system or outside of the washing system.
- 10 The present invention further provides a wash extractor for wet treatment of laundry articles, characterized in that the wash extractor is provided with cooling means, adapted for direct cooling air, which air is located within a compartment of the washing system or outside of the washing system.
- 15 The cooling means are preferably for cooling ambient air and are suitable to cool foam. The cooling means are installed in that way that the cooling effect is directed to those locations of the washing system where undesired foaming occurs, for example the area of the water-extracting device or the overflow or storage tanks associated with the tunnel washer, which tanks serve as receptacle
- 20 for excess wash liquid, wash liquid to be used, used wash liquid, wash liquid which may be re-used, as well as rinse liquid, press liquid or liquid drained from a centrifuge.
- In another embodiment the cooling means cool metal sheets, such as slides
- 25 connecting the continuous batch washer with the water-extraction device (press or centrifuge), or container walls or grids which may come into contact with foam, in order to cool the foam thereby reducing the volume of the foam.
- In a preferred embodiment of the washing system according to the present
- 30 invention the means for cooling is a blower or fan for applying cold air.

Examples

Example 1: Foam regulating test in a container

Foam was generated by mixing a detergent composition containing a foaming
 5 detergent with tap water (10 g/l, pH 12.2, temperature 23°C). The foaming was
 driven by a basis detergent composition which comprises 30% non-ionic
 surfactants, 15% polycarboxylates, 2.5% soap and 2.5% phosphonates by weight
 of the detergent. Foam was produced in two containers labeled a) and b) each
 comprising 1 liter wash liquid by agitating the same. After a volume of foam of
 10 about 1 liter floating on the wash liquid had been produced agitation was stopped.
 100g crushed ice was added to container a) while the comparative sample in
 container b) was not treated. The foam treated with ice cubes was rapidly reduced
 as shown in the table 1. Foam % refers to initial height of 1 L of foam before
 treatment set at 100%.

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Table 1: Reduction of foam volume by addition of crushed water ice

amount of foam in % in relation to the start value	0 min	5 min	8 min	10 min
a: foam level, addition of crushed ice	100 %	82 %	71 %	71%
b: foam level, no treatment	100 %	100 %	100 %	87.5 %

The experiment showed that the addition of ice as cooling agent strongly reduced
 the volume of foam.

20

Example 2: Foam regulating test in a wash extractor

Foam was generated by mixing a detergent composition containing a foaming
 detergent with tap water in a wash extractor (detergent composition 10 g/l in 25 l
 tap water, pH 12.2) and heating the resulting wash liquid to a temperature of 40°C
 25 and agitating. The foaming was driven by the composition of basis detergent
 which comprises 30% non-ionic surfactants, 15% polycarboxylates, 2.5% soap
 and 2.5% phosphonates by weight of the detergent.

In the comparative example the wash liquid in the wash extractor was agitated until a foam height of 23 cm had been produced. Then agitation was stopped. After 10 minutes the foam height was 18 cm. This corresponds to a foam reduction of 22%.

5

In the example according to the invention the wash liquid in the wash extractor was agitated until a foam height of 23 cm had been obtained. Then agitation was stopped and 10 liter crushed ice was immediately added to the wash liquid. After 10 minutes the foam height was 13 cm. This corresponds to a foam reduction of 44%. In table 2 the results of example 2 are summarized.

10

Table 2: Reduction of foam volume by addition of crushed water ice

test	detergent composition in water	water content / temp.	addition of ice	foam height	foam reduction
comparative example	10 g/l	25L 40 °C	-	0 min: 23 cm 10 min: 18cm	-22%
inventive example	10 g/l	25L 40 °C	10 L crushed ice = 5.30 kg	0 min: 23 cm 10 min: 13cm	-44%

The experiment showed that the addition of ice as cooling agent strongly reduced the volume of foam.

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Example 3: Foam regulating test on a metal plate

Foam was generated by mixing a detergent composition containing a foaming detergent with tap water (10 g/l, pH 12.2) and heating the resulting wash liquid to a temperature of 23°C and agitating. The foaming was driven by a basis detergent composition which comprises 30% non-ionic surfactants, 15% polycarboxylates, 2.5% soap and 2.5% phosphonates by weight of the detergent. Foam was taken from the wash solution and transferred to a metal plates having the following dimensions: 20x24cm, 0.2cm, steel. The temperature of the metal plates were preset to -30°C and 22°C, respectively. Each foam spot had the appearance of a round spot with a diameter of 15 cm and a maximum height of 4 cm in the middle of the foam cake. At the beginning of the experiment the temperature of the metal

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plates were -30°C and 22°C , respectively, and the tests were carried out at an air temperature of 22°C .

After placing the foam cakes onto the plates it was observed that the foam bubbles of the foam placed on the cooled metal plate (-30°C) became smaller than the foam bubbles placed on the metal plate having room temperature (22°C). Within 10 minutes in both cases a wet film without bubbles developed around the base of the foam cake. The breadth of the wet film around the base of the foam cake on the cooled metal plate (-30°C) was 1.9 cm and 0.8 cm on the warm metal plate (22°C). In table 3 the results of example 3 are summarized.

Table 3: Reduction of foam volume on metal plates having different temperatures

	time	inventive example	comparative example
temperature of metal plate	t_0	-30°C	22°C
	t_{10}	-20°C	22°C
appearance of foam cake	t_0	round spot	round spot
	t_{10}	round spot	round spot
diameter of foam cake	t_0	15 cm	15 cm
	t_{10}	11.2 cm	13.4
size of base of foam cake	t_0	706 cm^2	706 cm^2
	t_{10}	394 cm^2	564 cm^2
reduction of size of base of foam cake		-44 %	-20 %
breadth of wet ring	t_{10}	1.9	0.8

The experiment showed that the foam placed on the cooled plate liquefied faster and consequently the volume of the foam was reduced stronger than on the plate having room temperature.

Claims

1. A method for reducing the volume of foam derived from wash liquid or from a detergent composition, characterized in that the foam is subjected to cooling.
5
2. The method of claim 1, wherein cooling means are applied in order to cool the foam.
3. The method of claim 1 or 2, wherein the temperature of the gas or vapour
10 enclosed within the foam bubbles is decreased.
4. The method of any one of claims 1 to 3, wherein the cooling of the foam is carried out by the addition of solid objects which float on the surface of the wash liquid and have a temperature of 10 °C or less.
15
5. The method of any one of claims 1 to 4, wherein the cooling of the foam is carried out by the addition of ice particles.
6. The method of any one of claims 1 to 4, wherein the cooling of the foam is
20 carried out by the addition of solid carbon dioxide.
7. The method of any one of claims 4 to 6, wherein said solid objects, said ice particles and said solid carbon dioxide, respectively, are added to the wash liquid.
- 25 8. The method of any one of claims 1 to 3, wherein the cooling of the foam is carried out by decreasing the temperature of components of the equipment used for the wet treatment of laundry articles, with which equipment components the foam comes into contact.
- 30 9. The method of any one of claims 1 to 3, wherein the temperature of the environment surrounding the foam is decreased by at least 10 °C.
10. The method of any one of claims 1 to 3, wherein the temperature of the ambient air surrounding the foam is decreased by at least 10 °C.

11. The method of any one of claims 1 to 3, wherein the temperature of the ambient air surrounding the foam is decreased to a temperature which is at least 10 °C lower than the temperature of the wash liquid.

5

12. The method of any one of claims 1 to 3, wherein the cooling of the foam is carried out by treatment of the foam with a cold gaseous medium.

13. The method of any one of claims 1 to 12, wherein those surfactants initially
10 contained in the wash liquid, when added in an amount of 0.1 weight % in an aqueous solution give a foam height of at least 10 cm as measured in the Ross Miles Foam Test.

14. The method of any one of claims 1 to 12, wherein the detergent
15 composition used to prepare said wash liquid, which detergent composition when added in an amount of 0.1 weight % to an aqueous solution give a foam height of at least 5 cm as measured in the Ross Miles Foam Test.

15. The method of any one of claims 1 to 12, wherein the detergent
20 composition used to prepare said wash liquid contains less than 20 weight %, preferably less than 15 weight %, further preferred less than 10 weight %, still further preferred less than 5 weight %, even further preferred less than 2 weight %, even more preferred less than 1 weight % and most preferred no de-foamer.

25 16. A method for the wet treatment of laundry articles comprising the steps of washing, rinsing and drainage, wherein the wet treatment is carried out in a washing system, wherein during the washing step a detergent composition is used in the wash liquid, wherein foam which is formed during the operation of the washing system is reduced by subjecting the foam to cooling.

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17. The method of claim 16, wherein the foam has been formed during the handling of the wash liquid.

18. The method of claim 16 or 17, wherein the foam has been formed during drainage of the laundry articles.

19. The method of any one of claims 16 to 18, as defined in any one of claims
5 2 to 15.

20. A washing system for wet treatment of laundry articles comprising a continuous batch washer and a drainage system, characterized in that the washing system is provided with cooling means.

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