A method for treating laundry with washing lye uses a washing machine having a lye discharge system disposed on a base of a lye container, a pivotally supported drum, and a heating device for the direct heating of a load of laundry containing the washing lye. The method includes adding the washing lye to the load in an amount smaller or equal to an amount required for saturation of the laundry with water ("saturation amount"), wetting the laundry, and heating the wetted laundry via the heating device. Water is added at a temperature of no more than 40 degrees Celsius for rinsing the washing lye from the laundry. A washing machine is also configured to be suitable for carrying out the method.
METHOD FOR TREATMENT OF LAUNDRY AND WASHING MACHINE SUITABLE FOR THIS PURPOSE

[0001] The invention relates to a method for the treatment of laundry in a washing machine and a washing machine especially suited to carrying out said method.

[0002] With known washing methods, the laundry to be washed is treated by an amount of water which is sufficient to saturate the laundry with water, and an additional minimum amount of free liquor, generally two to three liters, which enables a material exchange between the liquor absorbed by the laundry and the free liquor. In this way, in particular, a transfer of heat between the heater—which heats the free liquor—and the laundry can take place. The setting of the amount of water is generally ensured in individual cases by a suitable method for regulating the water level in the drum and matching the amount to the absorption capacity of the laundry. The free liquor results from a subtraction of the amount of water absorbed by the laundry from the amount of water added to the washing machine. Cotton material holds approximately 200% of its own weight, so that a 6 kg load of cotton material absorbs approximately 12 liters of water.

[0003] With this method, the continuous exchange between the absorbed liquor and the free liquor during heating causes the wash-active substances to be drawn into the laundry and the dissolved dirt to be removed. Because many kinds of soiling in or on the laundry can only be dissolved at higher temperatures, both the free and absorbed liquor has to be heated during the heating process.

[0004] The energy consumption of a washing machine is essentially determined by the energy required to heat the water. A reduction in the amount of water in a washing machine would therefore be desirable, especially a reduction in the amount of free liquor. However, with a conventional washing machine the heat transport from the heater into the laundry must be guaranteed by the free liquor. It is therefore difficult to achieve any reduction in the free liquor and thus a reduction in the energy consumption.

[0005] Known measures to reduce the free liquor in a drum-type washing machine are a reduction in a gap between the drum and the lye container or an external heating of the liquor in a flow heater. Common to all known measures is, however, the requirement to heat an additional, even if reduced, amount of free liquor.

[0006] An object of the invention is therefore the provision of a method for the treatment of laundry in a washing machine by means of which energy and/or water can be saved compared with the known methods.

[0007] An object of the invention is furthermore to disclose a washing machine suitable for performing this method.

[0008] According to the invention, these objects are achieved by a method with the features of claim 1 and by a washing machine with the features of claim 11. Preferred embodiments of the invention are given in the respective dependent claims. Furthermore, preferred embodiments of the method correspond to preferred embodiments of the washing machine and vice versa, even if not explained in detail here.

[0009] The invention therefore refers to a method for the treatment of laundry using washing lye in a washing machine comprising a lye discharge system disposed on the base of a lye container, a rotary-mounted drum and a heating device for the direct heating of a load of laundry containing the washing lye, with the method comprising the following steps.

[0010] a) Adding the washing lye to the load (a1) in an amount (a2) smaller or equal to an amount (a3) required for saturation of the laundry with water ("saturation amount"), and wetting the laundry;

[0011] b) Direct heating of the wetted laundry by means of the heating device; and

[0012] c) Adding water at a temperature \( T_{\text{w}} \) of not more than 40°C for rinsing the washing lye from the laundry.

[0013] In a preferred embodiment of this method, step c) is not carried out until after step b) has been completed.

[0014] The temperature \( T_{\text{w}} \) of the water in step c) preferably does not exceed 30°C.

[0015] The direct heating of the washing lye contained in the laundry preferably takes place by means of hot foam, hot air, steam and/or electromagnetic radiation which has/have been achieved by using the heating device.

[0016] The heating device for direct heating of a load containing the washing lye can be fitted at various points in the inventive washing machine. Preferably, the heating device is arranged in the lye container, especially in the drum.

[0017] Where the wetted laundry is heated by hot foam following step a), the hot foam is preferably generated by rotating the drum at a speed \( U_1 \), which is less than the contact speed \( U_2 \) of the laundry, the heating device is switched on and the foam is heated. The contact speed \( U_2 \) of the laundry is the speed of the drum at which the laundry can lie against an inner wall of the drum, for example a speed in the 300 to 500 r.p.m. range.

[0018] If heating takes place using hot foam, a direct heating of the laundry can be achieved. The temperature gradient can be adjusted by means of the output of the heating device and the density of the foam. Because the surface of the laundry is heated first, it is advantageous if the laundry is intensively turned over. This can advantageously take place by a reversing operation of the drum at a speed of 30 to 100 r.p.m.

[0019] The heating in step b) using electromagnetic radiation is preferably achieved by using a microwave heater and/or an infrared radiator (IR radiator).

[0020] When heating using microwaves, a direct heating of the wash lye (surfactant solution) absorbed in the laundry is also possible. In this case, the temperature gradient can be set by means of the microwave power. When using a microwave heater, care must be taken to make sure that no short circuits occur due to any metallic particles contained in the laundry. Furthermore, certain man-made fibers may not be stable when heated using microwaves. Damage to laundry can occur, for instance where there are seams of polyester.

[0021] When heating using an IR radiator, direct heating of the laundry is also possible. The temperature gradient can be set by means of the output IR radiator. Especially because the surface of the textile items is heated, an intensive distribution of the laundry by a reversing operation of the drum is advantageous.

[0022] The heating of the wetted laundry using hot air has the advantage that a temperature gradient can be set by means of which heat losses can be reduced.

[0023] In principle, a heater known from a tumble dryer can be used to generate the hot air. The use of hot air is therefore particularly advantageous for combination units which combine the function of a washing machine and a tumble dryer.

[0024] When heating using hot steam, the air can be saturated with steam (saturated steam) or be unsaturated at the
applied temperature. The advantage of the use of hot steam is the improved heat transmission between the heater and water.

In an inventive method, the drum in step b) is preferably operated in a reversing operating mode for a period of 10 to 30 minutes at a speed of 30 to 100 r.p.m., preferably 40 to 70 r.p.m. This achieves a particularly good distribution of the laundry so that the heating of the wetted laundry, which generally takes place on its surface, can take place as uniformly as possible due to the improved accessibility of the surface.

In step c), the dirt still remaining in the laundry and essentially only slightly dissolved in step b) can be rinsed out.

With the completion of step c), the actual washing operation is generally finished. In a further program sequence, the laundry can then be rinsed and spun in a conventional wash program.

For example, with a load (a1) of 6 kg of washing consisting of cotton material an amount of water (a2) of 10 liters (for example 8 liters where steam is used) could be used.

For cotton material, the saturation amount (a3) of water is approximately double a load (a1). From man-made fibers, which absorb water to a lesser degree, the saturation amount (a3) can be significantly lower. The values for the saturation amount (a3) are known per se, so that the amount of water (a2) can be preset in a wash program.

In this case, the load (a1) can be determined using known means. Advantageously therefore, in the inventive method a first sensor can be used to determine the amount of liquid or foam present in the lye container, it being possible for the sensor signal of said signal to be tracked during the process.

To determine the load (a1), a hydrostatic pressure p, for example measured in step a) with the aid of the first sensor, can be compared with the filled amount of water or washing lye present. The laundry present in the drum soaks up water or washing lye, which therefore cannot contribute to an increase in the hydrostatic pressure. By comparing the measured hydrostatic pressure p and/or the time gradient of the hydrostatic pressure p with corresponding values stored in a program controller of a washing machine for the saturation of laundry, the batch of laundry (load)(a1) and its degree of saturation (degree of wetting) can be determined. As a result, the duration of the wetting in step a) can be very precisely adjusted to the predetermined batch of laundry. Therefore, a wetting of the batch of laundry adequate for the inventive method can generally be signaled to a program, so that step a) is ended and step b) can be started.

With the inventive method, monitoring of a temperature in the drum is advantageous. In this case it is preferable if a second sensor for determining the temperature in the washing machine is fitted in the drum.

The amount of water or washing lye to be used in the inventive method can be additionally reduced if during step a) and/or step b) the drum is rotated at a higher speed. In this case, for instance, the water/washing lye contained in the laundry is centrifuged and a reduction in the amount of water or washing lye required for saturation is achieved.

The object of the invention is furthermore a washing machine with a program controller for controlling a program sequence, a drum rotatably mounted in a lye container, a lye discharge system arranged on the base of the lye container and a drive motor for the drum, with the washing machine additionally having a heating device for direct heating of a load (a1) of laundry containing the washing lye.

In a first preferred embodiment, the heating device is a device for generating steam or hot air. In a second preferred embodiment, the heating device is a microwave heating device and/or an IR radiator.

The inventive washing machine preferably has a first sensor for determining an amount of liquid or foam present in the lye container, with it being preferably possible to track the sensor signal during the process.

It is furthermore preferred if a second sensor for determining a temperature in the drum is arranged in the inventive washing machine.

The invention has the advantage that a substantially lower amount of water or washing lye is heated compared with a conventional method. This amount corresponds essentially to the amount necessary for saturating the laundry, which can be further reduced by a suitable fast rotation of the drum during the heating. This enables a substantial saving of water and energy.

An exemplary embodiment of the invention is explained in more detail in the following with the aid of FIG. 1.

FIG. 1 is a schematic representation of the parts of an embodiment of a washing machine relevant for the following description, in which a method as described above can be carried out. Other embodiments are conceivable.

The washing machine of the embodiment shown in FIG. 1 has a lye container 1 in which a drum 2 is rotatably mounted and can be driven by a drive motor 14. The rotary axis 3 of the drum 2 is directed forwards and upwards from the horizontal at a small angle (e.g. 13°), so that easier access and a view of the inside of the drum 2 are provided. Laundry vanes 4 enable a distribution of the laundry 7 when the drum 2 is rotating. Scoops 5 enable an intensive rinsing of the cleaned laundry 7 with water 6.

With the embodiment shown in FIG. 1, a heating device 16 is fitted outside of the lye container 1 and drum 2. The heating device 16 shown in FIG. 1 can especially provide hot air or steam.

As an alternative, foam, introduced in step b) of the method described above and generated with the laundry 7 by rotation of the drum 2, can be heated by a heating device 13 arranged on the base of the lye container 1. When the drum is rotated, the washing lye is partially centrifuged out of the laundry 7 and intensively mixed with air so as to produce foam. The rotating drum 2 can also entrain air in the washing lye, which is located in the lye container 1 under the drum 2, and thus produce foam. The formation of foam can be assisted by adding a suitable detergent to the washing lye.

The washing machine in FIG. 1 also has a lye supply system 8, 9, 10, which includes a water connecting fitting for the domestic water supply system 8, an electrically controlled valve 9 and a supply pipe 10 to the lye container 1, with it also being possible for the supply pipe to be routed if necessary via a detergent flushing device (flushing tray) 11, from which the supply water can transport a detergent, contained therein, into the lye container 1. The valve 9, and also the heating device 13, can be controlled by a controller (program controller) 12.
relative to a program, which can be linked to a time program and/or the achievement of certain measured values of parameters within the washing machine such as the speed of the drum 2.

[0047] A lye discharge system 18 with any necessary pipes, including a drain valve and lye pump is, because it is known per se, shown only schematically as an overview by means of an arrow. A first sensor 15 for measurement of hydrostatic pressure p is provided in the lye container 1. Furthermore, a second sensor 17 for determining a temperature is arranged in the drum. The second sensor 17 can also of course be located in an intermediate space between the lye container 1 and the drum 2.

[0048] In the embodiment shown here, in step a) of the method described above for treating laundry 7, water is introduced in an amount which is adequate to fill a space between the lye container 1 and the drum 2 at a bottom end of the drum with water and be able to wet the laundry 7. This washing lye is gradually absorbed by the laundry 7 until this has reached saturation wetting. There is no need to add further washing lye or water. The heating of the laundry 7 with the washing lye absorbed therein takes place directly and without the involvement of residual washing lye which has not been absorbed. In this way, dirt in the laundry 7 is initially dissolved, but not yet completely flushed out. This does not take place until the following step for which additionally added water is used, which is not or may not be very highly heated, which is not required to assist further in dissolving the dirt, but instead only to flushing it out of the laundry 7. A comparatively low temperature of a maximum of 40° C. is sufficient for this, possibly even only a maximum of 30° C. The required heating energy is also very low because the heating energy is initially required to be used only for the liquor absorbed in the laundry 7 to be treated.

1-14. (canceled)

15. A method for treating laundry with an aqueous washing lye in a washing machine, the washing machine containing a lye discharge system disposed on a base of a lye container; a rotationally mounted drum and a heating device for direct heating of a load of laundry containing the washing lye, which comprises the steps of:
   a) adding the washing lye to the load in an amount being smaller or equal to an amount required for saturation of the laundry with water, and wetting the laundry resulting in wetted laundry;
   b) directly heating the wetted laundry by means of the heating device; and
   c) adding water at a temperature of not more than 40° C. for rinsing the washing lye from the laundry.

16. The method according to claim 15, which further comprises not carrying out step c) until a completion of step b).

17. The method according to claim 15, which further comprises setting the temperature of the water to not more than 30° C.

18. The method according to claim 15, which further comprises performing the direct heating of the laundry containing the washing lye using at least one of hot foam, hot air, steam and electromagnetic radiation which has been achieved by using the heating device.

19. The method according to claim 15, which further comprises:
   a) heating the wetted laundry with hot foam, following step
   b) generating the hot foam by rotating the rotationally mounted drum at a speed which is less than a contact speed of the laundry, the heating device is switched on and the foam is heated.

20. The method according to claim 15, which further comprises effecting the heating in step b) by using electromagnetic radiation by one of a microwave heater and an IR radiator.

21. The method according to claim 15, which further comprises operating the drum in step b) in a reversing mode at a speed of 30 to 100 r.p.m. for a time period of 10 to 30 minutes.

22. The method according to claim 15, which further comprises setting a ratio of the amount to the amount to be between 0.5 and 0.9.

23. The method according to claim 22, which further comprises:
   a) heating the laundry with hot steam; and
   b) in step b) the ratio of the amount to the amount to be between 0.5 and 0.7.

24. A washing machine, comprising:
   a) a program controller for controlling a program;
   b) a lye container having a base;
   c) a drum rotatably mounted in said lye container;
   d) an lye discharge system disposed on said base of said lye container;
   e) a drive motor for driving said drum;
   f) a heating device for heating a load of laundry containing a washing lye.

25. The washing machine according to claim 24, wherein said heating device is a device for generating one of steam and hot air.

26. The washing machine according to claim 24, wherein said heating device is selected from the group consisting of microwave heating devices and an IR radiator.

27. The washing machine according to claim 24, wherein said heating device is disposed in said lye container.

28. The washing machine according to claim 24, further comprising a sensor for determining a temperature and disposed in said drum.

29. The washing machine according to claim 24, wherein said heating device is disposed in said drum.

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