Substitution of Sodium perborate by Sodium percarbonate in colour fastness testing of textiles.*

Solid heavy duty laundry detergents count among the most efficient washing materials. They contain, among other important components, bleaching agents and bleach activating compounds for the effective removal of stains and to improve the degree of whiteness. In the past few decades sodium perborate has been used as the bleaching agent. Because the bleaching effect is only active above 60°C, so-called bleaching activators have been developed to allow effecting bleaching at lower temperatures.

The demand for energy saving, as well as the availability of modern washing agents, has led to the fact that e.g. in Germany almost 70% of all washings today are carried out at temperatures below 40°C.

Based on its better efficiency and environmental considerations, sodium percarbonate has replaced sodium perborate in modern washing agents.

Recently, the European officials have required that sodium perborate be replaced by sodium percarbonate. According to EU-DECREE No. 109/2012 dated 09 February 2012 various boron compounds, specifically perborates, may not be used in detergents after 20th June 2013. The basis for this is, that a range of boron compounds have been shown to be harmfull to the reproduction organs, and that sodium percarbonate is available as a good and reliable alternative to sodium perborate.

The difference between these two bleaching agents, sodium percarbonate and sodium perborate, lies in the amount of freely available hydrogen peroxide. Sodiumperborate releases only one molecule H_2O_2 and sodiumpercarbonate three of them. If therefore the amount of percarbonate is reduced according to this stochiometry the results in colour fastness tests to washing should be identical.

The German Fastness Committee (Deutsche Echtheitskommission) DEK , which is responsible for the determination of colour fastness in Germany, in collaboration with „Laundry and Home Care“, the development department of Henkel AG & Co KGaA., has carried out a series of comparative tests to determine whether the lower amounts of percarbonate relative to perborate gives the same results. Fo KGar these comparative tests, the A.I.S.E set (International Association of Soaps, Detergents and Maintenance Products) of 14 dyed colour monitoring samples has been used (Table 1).

Table 1: Charakteristic of A.I.S.E. Testdyeings.

A.I.S.E. Dyeing	Fabric	Dyestuff
AISE-01	Cellulose	Sulphur Black 1
AISE-03		Vat Green 1
AISE-05		Vat Blue 4
AISE-08		Direct Yellow 106
AISE-16		Reactive Red 141
AISE-20		Reactive Black 5 (1 %)
AISE-21		Reactive Black 5 (6 %)
AISE-22		Reactive Orange 16
AISE-24		Reactive Blue 71
AISE-26		Reactive Violet 5
AISE-27		Reactive Yellow 138:1
AISE-29		Reactive Orange 107, Reactive Red 198, Reactive Black 5
AISE-33	Polyester	Disperse Blue 284
AISE-39	Polyamid	Acid Red 315

ISO 105-CO9 was chosen as test procedure, because this method uses a higher concentration of bleaching agents than used in the normal washing test. The results are summarized in Table 2.

Table 2: Comparison of colour fastness ratings Sodium perborate/Sodium percarbonate

	Testing according to ISO 105-C09, Change in colour	
A.I.S.E. Dyeing	Sodium perborate	Sodium percarbonate
AISE-01	1-2	1
AISE-03	4-5	4-5
AISE-05	4	4
AISE-08	5	5
AISE-16	4-5	4-5
AISE-20	2-3	2-3
AISE-21	3-4	3
AISE-22	2-3	2
AISE-24	4	4
AISE-26	4	4
AISE-27	5	5
AISE-29	3	3
AISE-33	5	5
AISE-39	5	4-5

It is apparent from the table that the colour fastness ratings for the change in colour are within the usual tolerance of a half fastness rating, when the amount of sodium percarbonate is reduced in accordance to the stoichiometry.

Based on these results, DEK has carried out a series of internal round robin tests (ref1) in which the washing fastness of the chosen A.I.S.E. colour set was determined according to ISO 105-C08 at 60°C. The amount of sodium perborate to sodium percarbonate was set at 1:0.67 in accordance with the stoichiometry, which means that instead of 1g/l perborate only 0,67 g/l percarbonate was used. The test results of one participant using single adjacent fabrics are summarized in Table 3 and in the diagrams 1 and 2.

Table 3: Results on the chosen A.I.S.E. Colour Set for testing according to ISO 105-C08 for Sodium perborate and for Sodium percarbonate.

	Testing according to ISO 105-C08					
A.I.S.E. Dyeing	**Sodium perborate**			**Sodium percarbonate**		
	Staining CO	Staining CV	Colour change	Staining CO	Staining CV	Colour change
AISE-01	4	4-5	4	4	4-5	4
AISE-03	4-5	4-5	4-5	4-5	4-5	4-5
AISE-05	4-5	5	4	4-5	5	4
AISE-08	2	4	4-5	2	3-4	4-5
AISE-16	2-3	4-5	4-5	2-3	4-5	4-5
AISE-20	4-5	4-5	4-5	4-5	4-5	4-5
AISE-21	4-5	5	4-5	4-5	5	4-5
AISE-22	4	5	4	4	4-5	4
AISE-24	2-3	4	4	2-3	4	4
AISE-26	4-5	5	4	4-5	5	4
AISE-27	3	4-5	4-5	3	4-5	4-5
AISE-29	4-5	5	4	4-5	5	4
	Staining PES	Staining CO	Colour change	Staining PES	Staining CO	Colour change
AISE-33 (PES)	4-5	5	4-5	4-5	5	4-5
	Staining PA	Staining CO	Colour change	Staining PA	Staining CO	Colour change
AISE-39 (PA)	3-4	4-5	4	3-4	4	4

Diagram 1: Comparision staining for Cotton

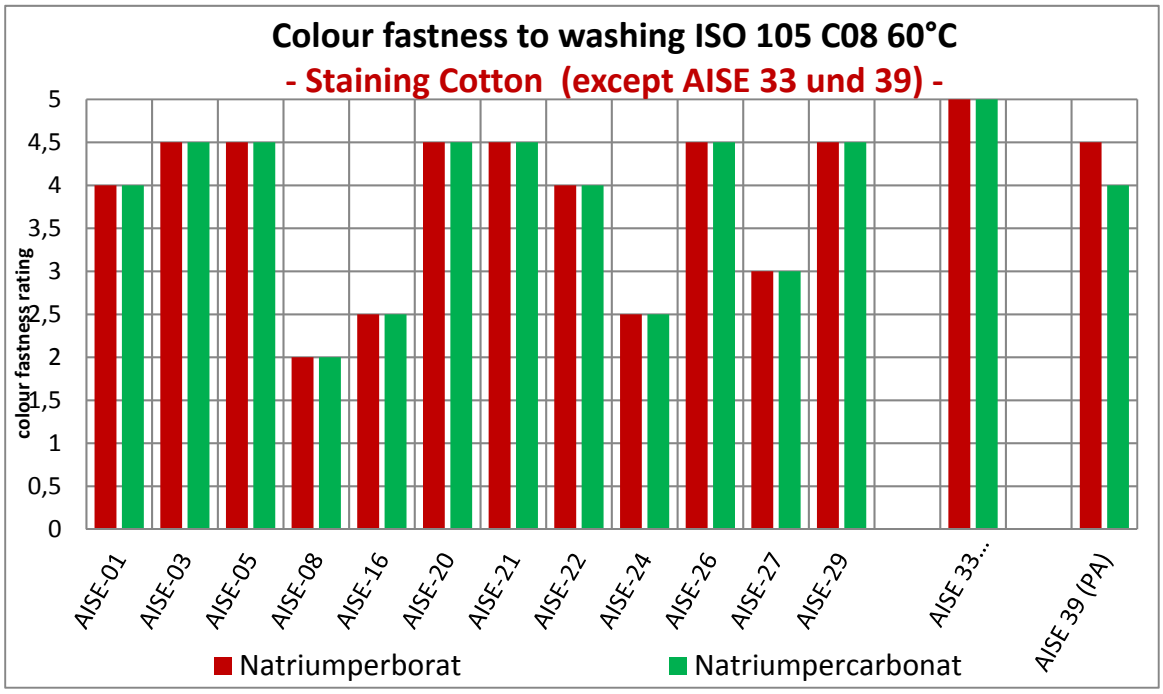


Diagram 2: Comparisation staining to viscose

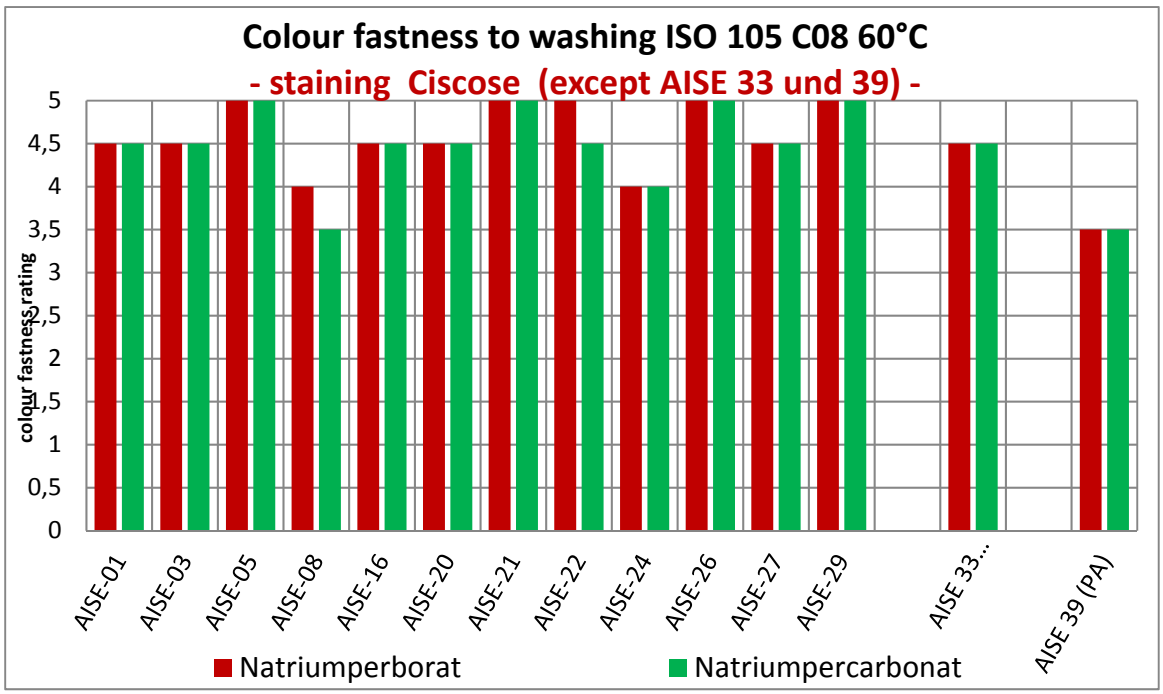
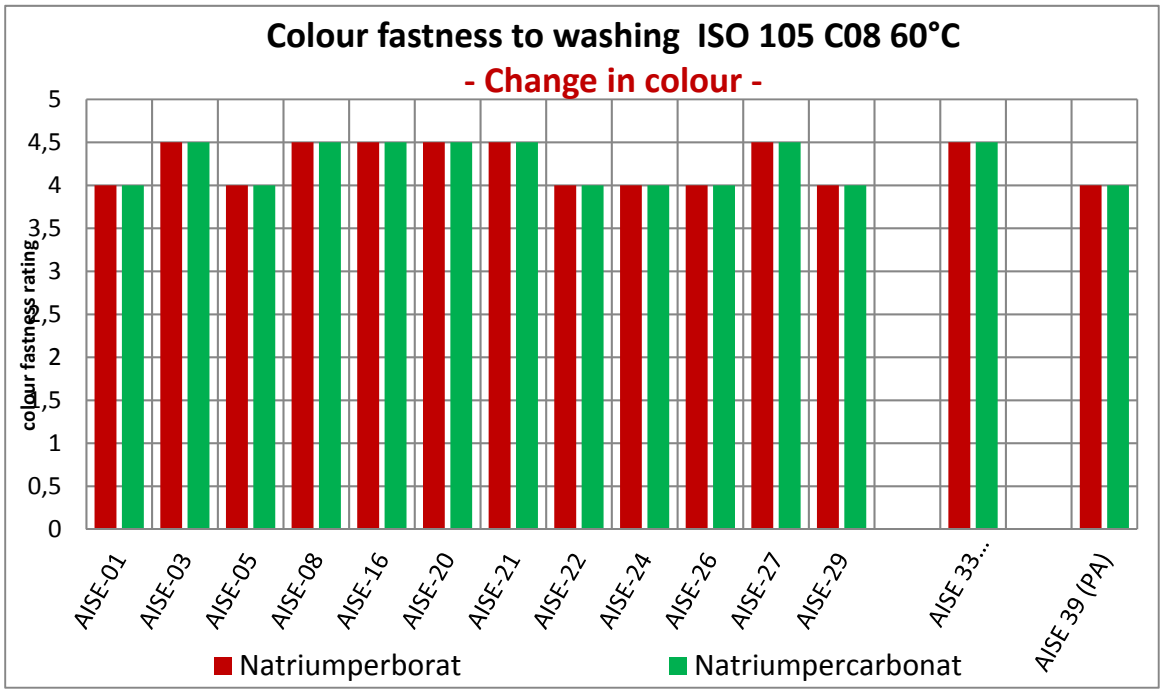


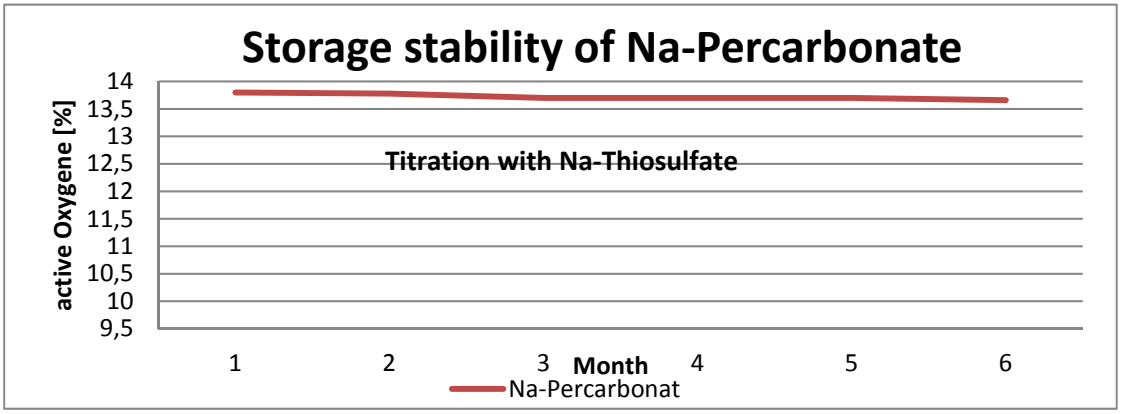
Diagram 3: Comparison change in colour



The results demonstrate that the replacement of sodium perborate by sodium percarbonate has no effect on the colour fastness ratings for change in colour, when the stoichiometry is taken into account. In total 406 washing tests have been carried out and only 1 % differ in one fastness rating, which means that 99 % are comparable.

Further, the storage stability of both substances is similar. No change in the amount of active oxygen could be determined after storage of the solid product for up to six months at temperatures below 10°C (Diagram 4).

Diagram 4: Sorage stability of sodiumpercarbonate.



Summary

The ban on the use of sodium perborate has no effect on the results of testing the colour fastness for change in colour according to ISO/DIN EN ISO 105-C series if sodium percarbonate is used as an equivalent substitution. When the amount of the bleach component in the reference detergent is taken into account so that the same amount of freely available peroxides are formed, the results of the tests agree. Also the storage ability of sodium percarbonate is similar to that of sodium perborate.

Since the washing agent industry has already changed to use sodium percarbonate, the standards of the ISO 105-C-Series need to be revised so that the reference detergent conforms with the heavy duty detergents currently available on the market.

With this study it could be shown, that for the daily laboratory practice an equivalent replacement for the banned sodium perborate is available. This should be shortly implemented in the standards of the ISO-105-C-series by the ISO/TC38/SC1-committees.

Reference

1) Weck A., Substitution von Natriumperborat-Tetrahydrat durch Natrium- carbonat-Peroxohydrat bei textilenP rüfungen, WIWeB R1/0000015933, Erding, 26.09.2014

***Authors**

Dr. Wolfgang Schiller	Former President of DEK e.V., Berlin
Ulrich Kraemer †	Former Managing Director of DEK e.V., Erding
Catrin Helbig	STFI, Chemnitz
Alexander Dietel	WIWeB, Erding President of DEK e.V., Erding
Andreas Metzger	TÜV Rheinland LGA Products GmbH, Cologne Managing Director of DEK e.V. and DEK GmbH, Erding
Thomas Rechenbach	Henkel AG & Co KGaA, Düsseldorf
Andreas Schönfeld	Zschimmer & Schwarz Mohsdorf GmbH & Co KG, Burgstädt