

The Detergency Assessment Report for  
Layered Sodium Silicate and Sodium  
Tripolyphosphate in Laundry Powder Formula  
Products

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The detergency assessment report for  
Layered sodium silicate and sodium tripolyphosphate in laundry  
powder formula products

The main contents of contract contained that:

Referenced laundry powder formula:

1) 12-15% Linear Alkyl Benzene Sulfonic Acid (LAS), 2) 8-10% soda ash, 3) 8-10% sodium silicate, 4) 8% Zeolite 4A and the rest: sodium sulfate.

2) The calcium exchange value and magnesium exchange value of layered sodium silicate A and layered sodium silicate B provided by TIANJIN CREDIT INTERNATIONAL CO., LTD. were tested by EDTA volumetric method;

3) In the referenced laundry powder formula provided by TIANJIN CREDIT INTERNATIONAL CO., LTD., 4A zeolite in the formula was respectively replaced by 15% layered sodium silicate A/STPP/silicate B to evaluate the influence of the same amount of layered sodium silicate A, layered sodium silicate B and STPP on the performance of the laundry powder.

Main research results:

1. Calcium ion exchange mass and magnesium ion exchange mass of layered sodium silicate A and layered sodium silicate B

The calcium ion exchange capacity and magnesium ion exchange

mass of layered sodium silicate A and B supported by TIANJIN CREDIT INTERNATIONAL CO., LTD. were tested according to GB/T 19421.4 and GB/T 19421.5, respectively. The results were shown in Table 1. The results indicate that layered silicate B demonstrates superior calcium and magnesium ion exchange capabilities, with its calcium ion exchange capacity far exceeding the standard values.

Table 1 Calcium ion exchange value and magnesium ion exchange mass of layered sodium silicate A and B

| Type             | Sample            | Average exchange mass<br>mg/g |
|------------------|-------------------|-------------------------------|
| Mg magnesium ion | Layer silicon A   | 243                           |
|                  | Layered silicon B | <b>288</b>                    |
| Ca calcium ion   | Layer silicon A   | 195                           |
|                  | Layered silicon B | <b>429</b>                    |

## 2. Solubility and pH of layered sodium silicate A, layered sodium silicate B and STPP

The solubility of sodium layered silicate A, sodium layered silicate B and STPP and pH at this concentration were tested, and the results are shown in Table 2.

Table 2 Solubility and pH of layered sodium silicate A, layered sodium silicate B and STPP

| Type              | Layered sodium<br>silicate A | Layered sodium<br>silicate B | STPP |
|-------------------|------------------------------|------------------------------|------|
| Solubility g/100g | <1                           | <3.5                         | <5.5 |
| pH                | 11.15                        | 11.56                        | 9.00 |

## 3. The solid content and pH of laundry powder with layered sodium

silicate and STPP

The solid content and pH value of several prepared laundry powders were shown in Table 3.

| Table 3 pH test results of laundry powder |        |        |        |
|-------------------------------------------|--------|--------|--------|
| Type                                      | 15 A   | 15 B   | 15 ST  |
| Solid content                             | 99.57% | 99.48% | 99.61% |
| pH                                        | 10.45  | 10.49  | 10.43  |

4. The detergency of laundry powders with layered sodium silicate and STPP

The detergency of the prepared laundry powders in different hardness of hard water was tested. The performance of 15B and 15ST products were compared below.

#### 4.1 Detergency of laundry powders in tap water

The detergency results of laundry powders with 15B and 15ST in tap water were shown in Figure 1. It can be observed that the two laundry powders demonstrated higher cleaning efficiency ratios for phosphorus-free powder indicators.

Note: The hardness of tap water in Taiyuan is approximately 250 ppm.

For the detergency of JB-01 (Carbon black contaminated cloth), the laundry powders samples containing STPP and layered sodium silicate B is basically the same, while for the detergency of JB-02 (Protein-stained cloth) and JB-03 (Sebum contaminated cloth), STPP is slightly stronger than that of layered sodium silicate B.

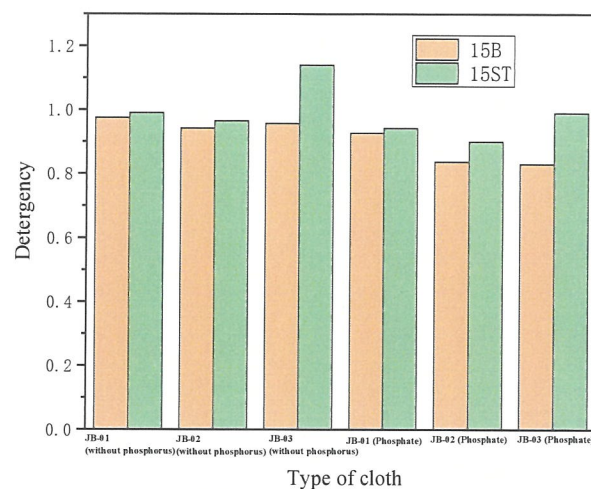


Figure 1 The detergency results of laundry powder in tap water (Note: the non-phosphorus in the figure represents the comparison with the non-phosphorus indicator powder, and the phosphorus represents the comparison with the phosphorus indicator powder)

#### 4.2 Detergency of laundry poeders with different water hardness

The detergency results of the laundry power with 15 layered sodium silicate and STPP in water with different hardness were tested, respectively, and compared with phosphorus-free powder indicators and phosphorus powder indicators. It can be seen that there was no strong regularity in the results.

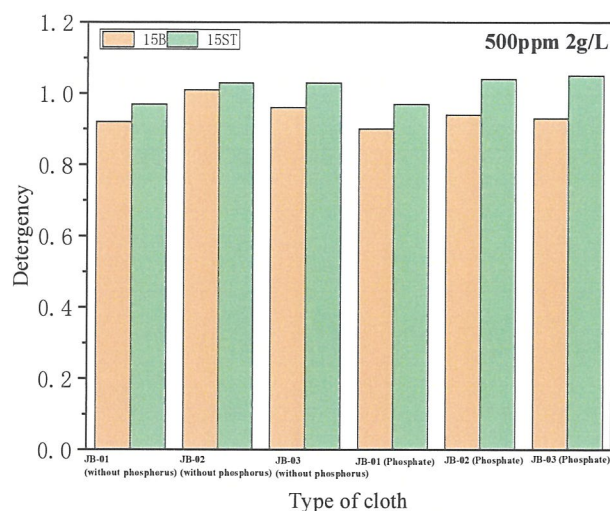


Figure 2. The detergency results of laundry powder in 500ppm hard water

Figure 3, Figure 4 and Figure 5 showed that the detergency results of laundry powder with hardness of 1000ppm, 1250ppm (2g/L) and 1250ppm (1g/L) respectively. It can be seen that there is no strong regularity in the whole.

However, the laundry powder containing layer silicon B showed good detergency in high hardness water. Especially, the detergency of JB-03 was higher than that of STPP containing samples, indicating that layer silicon B has good detergency in high hardness water.

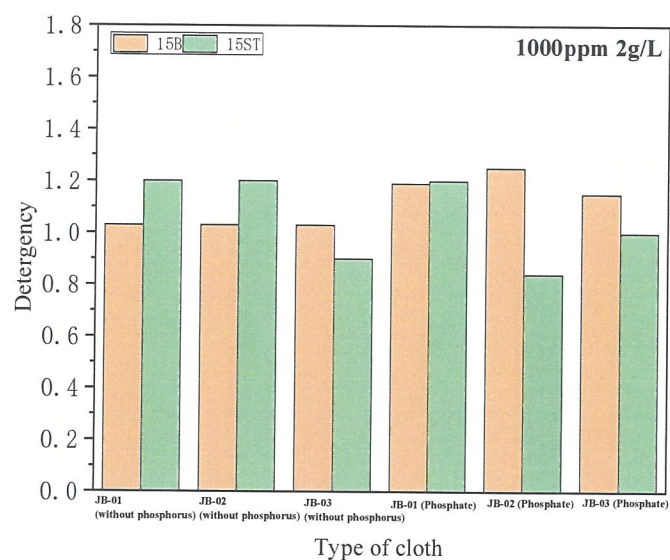


Figure 3 The detergency results of laundry powder in 1000ppm hard water Figure

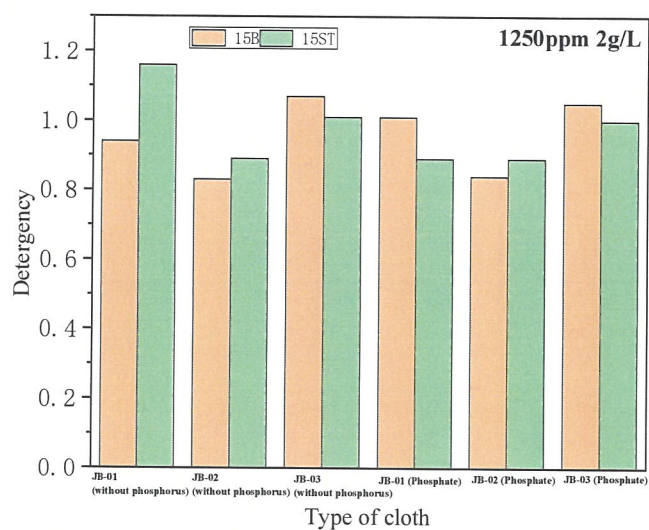


Figure 4 The detergency results of laundry powder in 1250ppm hard water and 2g powder

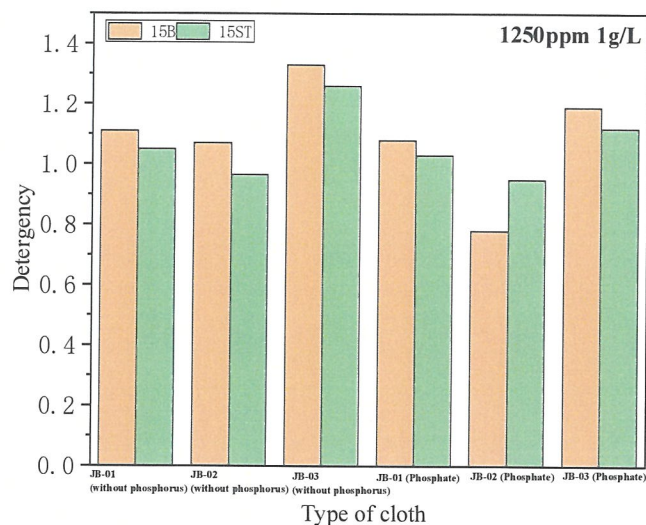


Figure 5. The detergency results of laundry powder in 1250ppm hard water and 1g powder

#### 4.3 Whiteness difference with standard laundry powder in different hardness water.

Table 4 showed the whiteness difference with standard laundry powder in different hardness. It can be seen that with the increase of water hardness, the whiteness difference with standard laundry powder showed decreasing trend, which was in line with the theoretical law.

Table 4 Whiteness difference with standard laundry powders in different

| Type of indicator powder | hardness water                    |       |       |                            |       |       |
|--------------------------|-----------------------------------|-------|-------|----------------------------|-------|-------|
|                          | Powder without phosphorus content |       |       | Phosphate indicator powder |       |       |
| hardness of water        | JB-01                             | JB-02 | JB-03 | JB-01                      | JB-02 | JB-03 |
| 250ppm                   | 10.69                             | 2.82  | 9.04  | 10.78                      | 2.88  | 10.30 |
| 500ppm                   | 7.93                              | 2.20  | 5.02  | 7.86                       | 1.85  | 5.02  |
| 1000ppm                  | 6.44                              | 1.43  | 4.07  | 5.58                       | 1.24  | 4.55  |
| 1250ppm                  | 5.79                              | 1.04  | 3.48  | 5.34                       | 1.03  | 3.91  |

## 5. Conclusions

(1) The average exchange mass of layered sodium silicate A for Ca is 195mg/g, and the average exchange mass of layered sodium silicate B for Mg is 243mg/g; the average exchange mass of layered sodium silicate B for Ca is 429mg/g, and the average exchange mass of layered sodium silicate B for Mg is 288mg/g;

(2) The solubility of layered sodium silicate B provided by TIANJIN CREDIT INTERNATIONAL CO., LTD. in water is less than 3.5, and the solubility of STPP in water is less than 5.5. The corresponding pH values at this solubility are 11.56 and 9.00 respectively.

(3) The solid content of laundry detergent containing 15% layered sodium silicate B and STPP is 99.48% and 99.61%, respectively. The pH of laundry detergent containing 15% layered sodium silicate B and STPP is 10.49 and 10.43, respectively.

(5) The detergency of the prepared laundry powder was tested in different hardness water. The layered sodium silicate B detergent demonstrated superior detergency in high-hardness water, making it particularly suitable for areas with elevated water hardness. This outcome was in line with high calcium ion exchange capacity of layered sodium silicate B.