# Liquid laundry detergent for household use

Local. Global. Integrated.


Operating in 17 countries, in 39 different locations, PCC SE currently employs over 3 300 people.

# About Us

PCC Exol SA is a major player in the European surfactants market. In the eastern and central-eastern part of the continent, it is the undisputed leader in its industry. Most of the production facilities and the company's headquarters are located in Brzeg Dolny, Poland. Here we develop, test and manufacture a wide range of anionic, non-ionic and amphoteric surfactants and speciality industrial formulations.

New products are continuously added to the portfolio in response to market trends and individual customer requirements. The surfactants produced at the plants have a very wide range of industrial applications. They are used as wetting agents, emulsifiers, auxiliaries in paper, metallurgy and many other industries, as well as in household chemicals, personal care products and textiles.

PCC EXOL pays special attention to the issue of sustainable development, which is one of the key elements of the company's strategy. In order to strengthen its competitive position in the surfactants market, the company is committed to promoting responsible production and consumption throughout the value chain. The concept of sustainable development is therefore a key aspect of all the company's management and operational processes.

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**PCC PCG**
**OXYALKYLATES**
**IRPC**

## Polyols

- Polyether polyols
- Polyester polyols
- Prepolymers
- Polyurethane Systems

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## Chlorine

- Chlorine
- MCAA
- Other Chlorine Downstream Product

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**ROKITA SA**

## Phosphorus

- Phosphorus derivatives
- Naphthalene derivatives
- Polycarboxyethers (PCE)

**PCC EXOL SA**
**PCC CHEMAX INC**
**PCC PCG OXYALKYLATES**

## Surfactants

- Anionic surfactants
- Cationic surfactants
- Nonionic surfactants
- Amphoteric surfactants (betaines)
- Chemical formulation

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## Alkylphenols

- Nonylphenol
- Dodecylphenol
- Tristyrylphenol

**PCC CONSUMER PRODUCTS SA**

## Consumer Products

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- Renewable Energy
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## Logistics

- Intermodal transport
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- Microsillica
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## Holding & Projects

- Portfolio Management
- Project Development

# Liquid laundry detergents for household use

The main task of detergents, designed for home laundry, is to remove stains and dirt from clothes using the lowest possible washing temperature and avoiding the need for prior soaking.

The choice of detergent and its amount depend on the size of the load, the hardness of the water, the colour and type of laundered fabrics. The effectiveness of the detergent depends primarily on the amount used for washing. An insufficient amount as well as an excess of it can result in worse washing results.

PCC Exol products can be used for both liquid and capsule detergents. Detergents in the form of laundry capsules are as effective as liquid detergents, with the added advantage of less water in the product itself, which is in line with the current zero waste trend. In addition, the concentrated form of the capsules allows for the transport of larger quantities compared to liquid detergents.

**The developed formulation is shown below:**

- Heavy Duty Liquid Detergent, HDLD
- Universal Liquid Detergent, ULD
- Low-Temp Liquid Detergent, LTLD
- Baby Laundry Detergent, BLD
- Laundry Capsules, LC

## Detergency

Detergency - the ability of the detergent to remove soils from the fabric surface during the laundering process. Detergency tests were performed using to own method on fabric soiled with standard, different dirt: 1. Fluid make-up, 2. Curry, 3. Blood, aged, 4. Wine, aged, 5. Spaghetti sauce with beef, 6. Chocolate ice cream, aged, 7. Grass/mud, with thickening agent, 8. Highly discriminative tea, 9. Grass, pure, 10. Baby food carrot/potato, 11. Standard clay, 12. Beta-carotene on cotton, circular stain, 13. Dirty Motor Oil (DMO), 14. Butterfat with colourant, 15. Beef fat, coloured with Sudan Red.

### Tested dirt divided into three categories:

**Enzymatic**
- Blood, aged
- Chocolate ice cream, aged

**Bleachable**
- Curry
- Wine, aged
- Grass/mud, with thickening agent
- Highly discriminative tea
- Grass, pure
- Standard clay
- Beta-carotene on cotton, circular stain
- Baby food carrot/potato

**Greasy**
- Fluid make-up
- Spaghetti sauce with beef
- Butter with colourant
- Beef fat, coloured with Sudan Red
- Dirty Motor Oil (DMO)

### Test conditions:

- automatic washing machine
- 40°C
- water hardness (13 °dH)
- cotton program
- load – 2 kg of dry, white towels
- the dosing of the market product was verified with the information on the label
- fabric soiled with standard dirt

After the washing process was performed, the standardly soiled fabrics were dried and then the degree of washing was assessed by measuring parameter dE* from the CIELab scale, as the difference between the initially stain and the degree of its washing.

Figure 1. Soiled fabric before washing

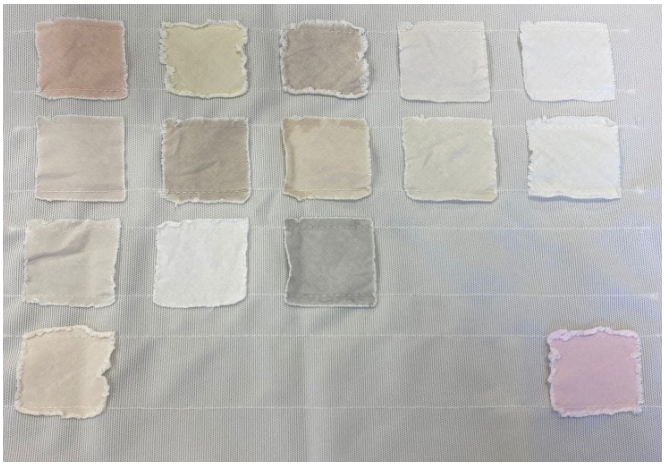


Figure 2. Fabric after washing

# Heavy Duty Liquid Detergent, HDLD

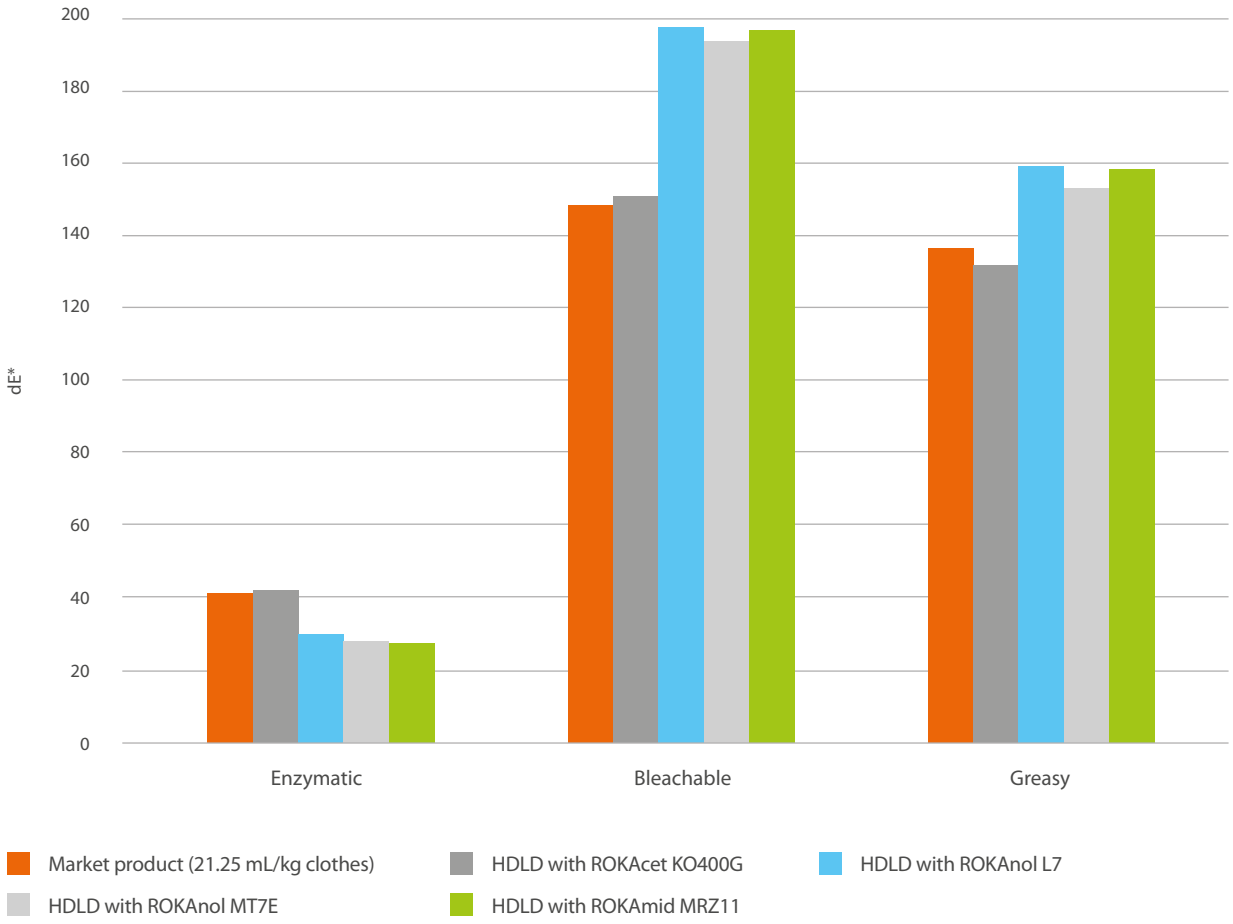
| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **Sodium Laureth Sulfate** | **SULFOROKAnol L227/1** | **30.0** | **Removes stains/ foaming agent** |
| **PEG-6 Glyceryl Cocoate/ Laureth-7/ Alcohols, C8-18-ethoxylated/ PEG 11-Rapeseedamide** | **ROKAcet KO400G/ ROKAnol L7/ ROKAnol MT7E/ ROKAmid MRZ11** | **10.0** | **Breaks down stains** |
| **Potassium Cocoate** | **EXOsoft PC35** | **3.0** | **Breaks down stains** |
| Trisodium Citrate | – | 2.5 | Chelator |
| Tetrasodium Glutamate Diacetate | – | 2.0 | Chelator |
| Enzymes | – | 0.2 | Breaks down different types of stains |
| Fluorescent brightener | – | 0.1 | Optical brightener |
| Citric Acid | – | for pH 7-8 | pH regulator |
| Aqua | – | up to 100.0 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | liquid |
| **pH** | | 7.5-8.5 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | <100 |

## Procedure:

**1.** Mix Fluorescent brightener with water.
**2.** Add Trisodium Citrate and mix until a homogeneous solution is obtained.
**3.** Then add SULFOROKAnol L227/1 and mix.
**4.** Add ROKAcet KO400G/ROKAnol L7/ROKAnol MT7E/ROKAmid MRZ11 and mix.
**5.** Then add EXOsoft PC35 and mix.
**6.** Add GLDA-Na4, mix.
**7.** Add Citric Acid to obtained pH in the mass around 7-8.
**8.** Finally, add Enzymes and mix until a clear liquid is obtained.

## Heavy Duty Liquid Detergents (15 mL/kg clothes)




Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

# Universal Liquid Detergent, ULD

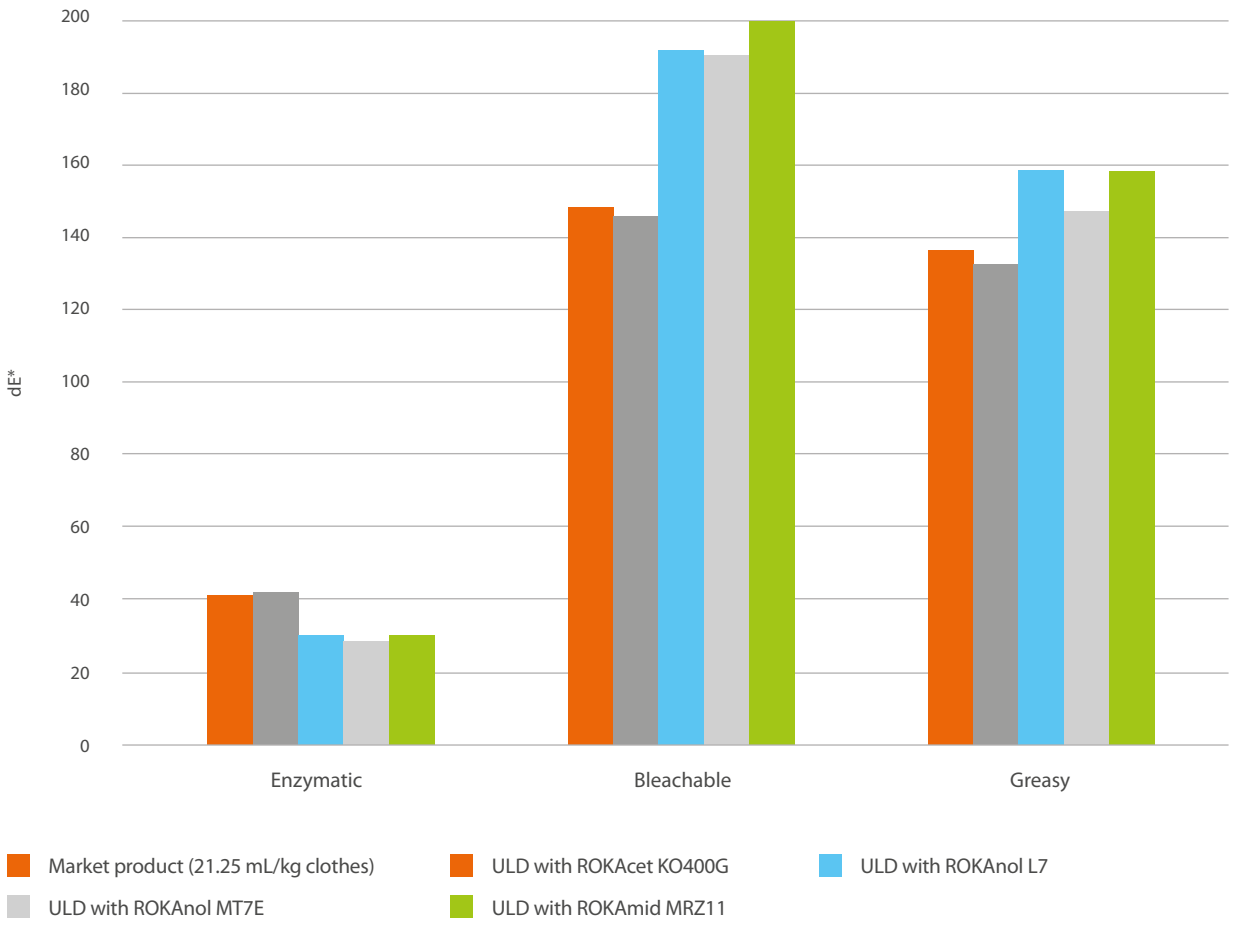
| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **Sodium Laureth Sulfate** | **SULFOROKAnol L227/1** | **40.0** | **Removes stains/ foaming agent** |
| **PEG-6 Glyceryl Cocoate/ Laureth-7/ Alcohols, C8-18-ethoxylated/ PEG 11-Rapeseedamide** | **ROKAcet KO400G/ ROKAnol L7/ ROKAnol MT7E/ ROKAmid MRZ11** | **10.0** | **Breaks down stains** |
| **Potassium Oleate** | **EXOsoft PO30** | **5.0** | **Breaks down stains** |
| Magnesium Laureth Sulfate | – | 5.0 | Removes stains/ foaming agent |
| Glycerin | – | 6.0 | Humectant |
| Tetrasodium Glutamate Diacetate | – | 2.5 | Chelator |
| Enzymes | – | 0.2 | Breaks down different types of stains |
| Fluorescent brightener | – | 0.1 | Optical brightener |
| Citric Acid | – | for pH 7-8 | pH regulator |
| Aqua | – | up to 100.0 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | liquid |
| **pH** | | 7.5-8.5 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | <100 |

## Procedure:

**1.** Mix Fluorescent brightener with water until dissolved.
**2.** Add SULFOROKAnol L227/1 and Magnesium Laureth Sulfate and mix until a homogeneous solution is obtained.
**3.** Then add ROKAcet KO400G/ROKAnol L7/ROKAnol MT7E/ROKAmid MRZ11 and mix.
**4.** Then add EXOsoft PO30 and mix a homogeneous solution is obtained.
**5.** Add Glycerin and mix.
**6.** Add GLDA-$Na_4$, mix.
**7.** Add Citric Acid to obtained pH in the mass around 7-8.
**8.** Finally, add Enzymes and mix until a clear liquid is obtained.

## Universal Liquid Detergents (15 mL/kg clothes)




Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

# Low-Temp Liquid Detergent, LTLD

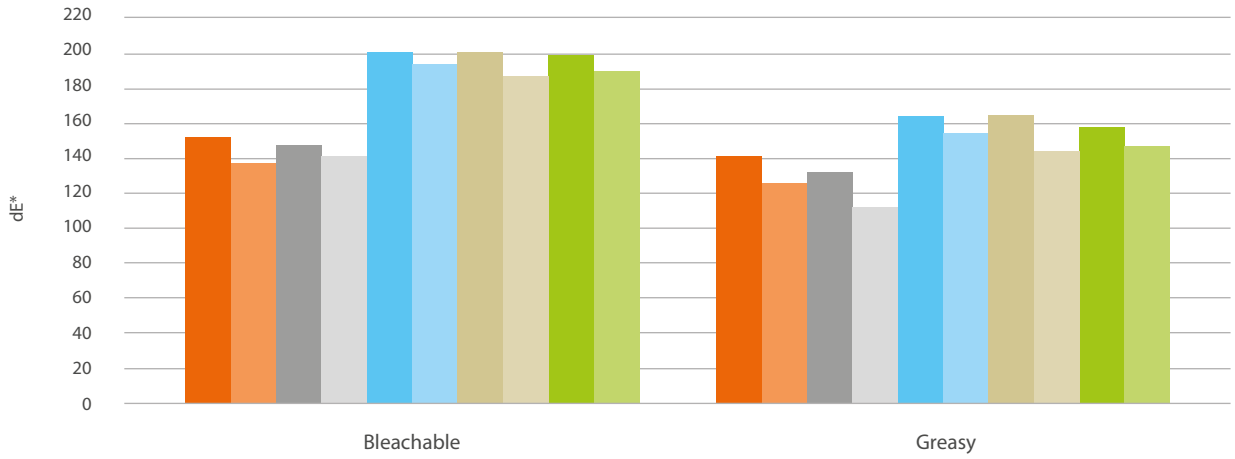
| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **Sodium Laureth Sulfate** | **SULFOROKAnol L227/1** | **38.0** | **Removes stains/ foaming agent** |
| **PEG-6 Glyceryl Cocoate/ Laureth-7/ Alcohols, C8-18-ethoxylated/ PEG 11-Rapeseedamide** | **ROKAcet KO400G/ ROKAnol L7/ ROKAnol MT7E/ ROKAmid MRZ11** | **9.0** | **Breaks down stains** |
| **Potassium Cocoate** | **EXOsoft PC35** | **7.0** | **Breaks down stains** |
| Tetrasodium Glutamate Diacetate | – | 3.0 | Chelator |
| Trisodium Citrate | – | 2.5 | Chelator |
| Enzymes | – | 0.5 | Breaks down different types of stains |
| Fluorescent brightener | – | 0.1 | Optical brightener |
| Citric Acid | – | for pH ~ 7.5 | pH regulator |
| Aqua | – | up to 100.0 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | liquid |
| **pH** | | 8.0-8.5 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | up to 100 |

## Procedure:

1. Mix Fluorescent brightener with water until dissolved.
2. Add Trisodium Citrate and mix until a homogeneous solution is obtained.
3. Then add SULFOROKAnol L227/1 and mix.
4. Add ROKAcet KO400G/ROKAnol L7/ROKAnol MT7E/ROKAmid MRZ11 and mix.
5. Then add EXOsoft PC35 and mix a homogeneous solution is obtained.
6. Add GLDA-$Na_4$, mix.
7. Add Citric Acid to obtained pH in the mass around 7.5.
8. Finally, add Enzymes and mix until a clear liquid is obtained.

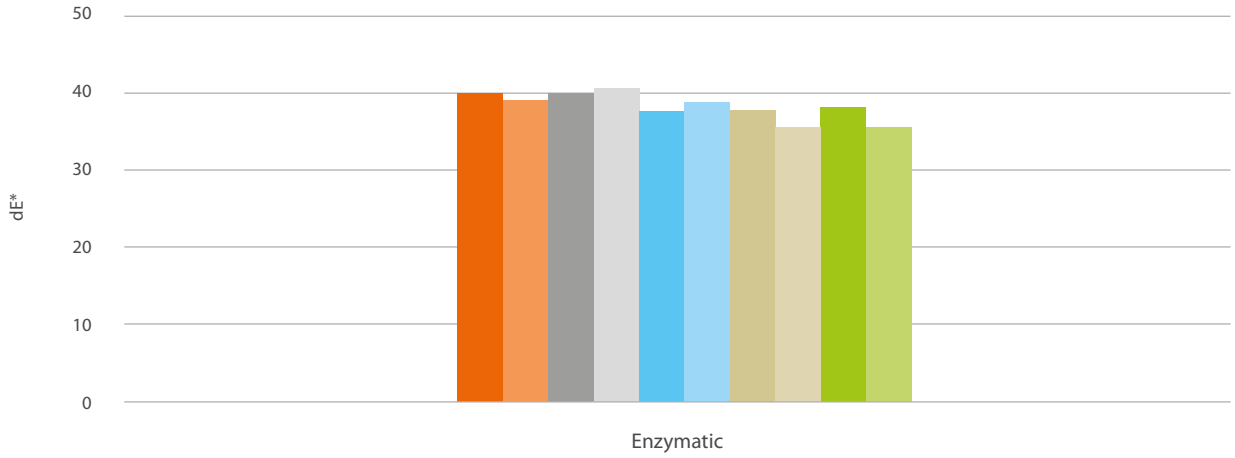
## Low-Temp Liquid Detergents (15 mL/kg clothes)




Market product 40°C (13.75 mL/kg clothes)
Market product cold tap water (13.75 mL/kg clothes)
LTLD with ROKAcet KO400G 40°C
LTLD with ROKAcet KO400G cold tap water
LTLD with ROKAnol L7 40°C
LTLD with ROKAnol L7 cold tap water
LTLD with ROKAnol MT7E 40°C
LTLD with ROKAnol MT7E cold tap water
LTLD with ROKAmid MRZ11 40°C
LTLD with ROKAmid MRZ11 cold tap water

Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

## Low-Temp Liquid Detergents (15 mL/kg clothes)




Market product 40°C (13.75 mL/kg clothes)
Market product cold tap water (13.75 mL/kg clothes)
LTLD with ROKAcet KO400G 40°C
LTLD with ROKAcet KO400G cold tap water
LTLD with ROKAnol L7 40°C
LTLD with ROKAnol L7 cold tap water
LTLD with ROKAnol MT7E 40°C
LTLD with ROKAnol MT7E cold tap water
LTLD with ROKAmid MRZ11 40°C
LTLD with ROKAmid MRZ11 cold tap water

Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

# Baby Laundry Detergent, BLD

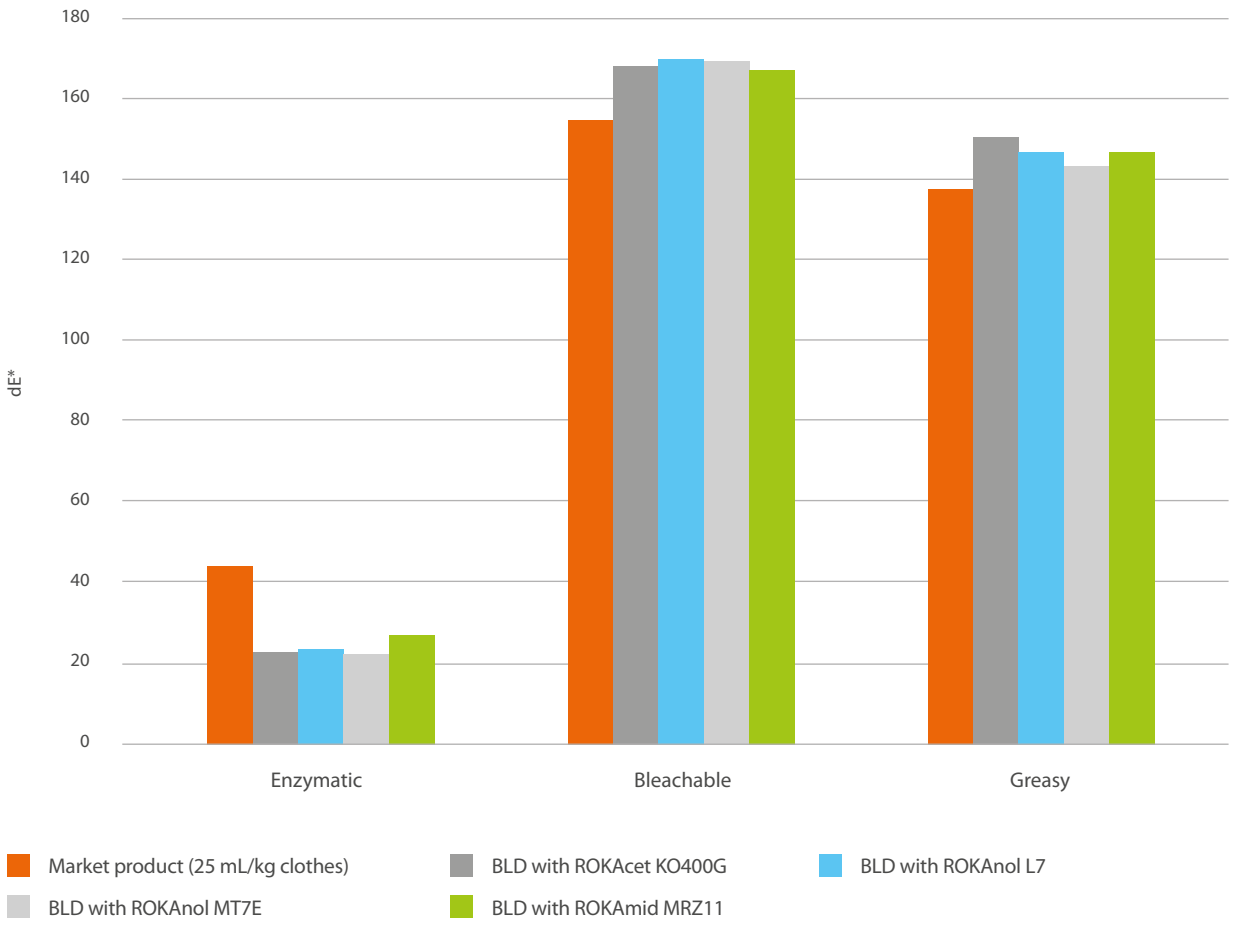
| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **Sodium Laureth Sulfate** | **SULFOROKAnol L227/1** | **35.0** | **Removes stains/ foaming agent** |
| **Potassium Oleate** | **EXOsoft PO30** | **5.0** | **Breaks down stains** |
| Magnesium Laureth Sulfate | - | 5.0 | Removes stains/ foaming agent |
| **PEG-6 Glyceryl Cocoate/ Laureth-7/ Alcohols, C8-18-ethoxylated/ PEG 11-Rapeseedamide** | **ROKAcet KO400G/ ROKAnol L7/ ROKAnol MT7E/ ROKAmid MRZ11** | **3.0** | **Breaks down stains** |
| Glycerin | – | 6.0 | Humectant |
| Tetrasodium Glutamate Diacetate | – | 2.5 | Chelator |
| Styrene/Acrylic Copolymer | – | 0.5 | Opacifier |
| Citric Acid | – | for pH ~ 9 | pH regulator |
| Aqua | – | up to 100.0 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | milky emulsion |
| **pH** | | 9 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | <100 |

## Procedure:

**1.** Mix SULFOROKAnol L227/1 with water until dissolved.
**2.** Add ROKAcet KO4W00G/ROKAnol L7/ROKAnol MT7E/ROKAmid MRZ11 and mix.
**3.** Then add Magnesium Laureth Sulfate and mix.
**4.** Add EXOsoft PO30 and mix.
**5.** Then add Styrene/Acrylic Copolymer and mix.
**6.** Add Glycerin, mix.
**7.** Add GLDA-$Na_4$, mix.
**8.** Finally, add Citric Acid to obtained pH in the mass around 9.

## Baby Laundry Detergent (15 mL/kg clothes)




Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

# Laundry Capsules, LC/1

| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **MIPA Laureth Sulfate (and) Propylene Glycol** | **SULFOROKAnol L290/1M/ SULFOROKAnol L390/1M** | **40.00** | **Removes stains/ wetting agent** |
| **PEG-6 Glyceryl Cocoate/ Laureth-7/ PEG 11-Rapeseedamide** | **ROKAcet KO400G/ ROKAnol L7/ ROKAmid MRZ11** | **32.00** | **Removes stains** |
| Glycerin | – | 17.95 | Humectant |
| Tetrasodium Glutamate Diacetate | – | 4.00 | Chelator |
| Enzymes | – | 1.00 | Breaks down different types of stains |
| Fluorescent brightener | – | 0.05 | Optical brightener |
| Sodium Hydroxide | – | for pH 8.0-8.5 | pH regulator |
| Aqua | – | 5.00 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | gel |
| **pH** | | 7.5-8.5 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | 600-1300 |
| **Water content [%]** | Karl Fischer method | <10 |

## Procedure:

**1.** Mix Fluorescent brightener with water until dissolved.
**2.** Add Glycerin and GLDA-$Na_4$, mix.
**3.** Add ROKAcet KO400G/ROKAnol L7/ROKAmid MRZ11 and mix.
**4.** Then add SULFOROKAnol L290/1M/SULFOROKAnol L390/1M, mix.
**5.** Add Sodium Hydroxide to obtained pH in the mass around 8.0-8.5
**6.** Finally, add Enzymes and mix.

# Laundry Capsules, LC/2

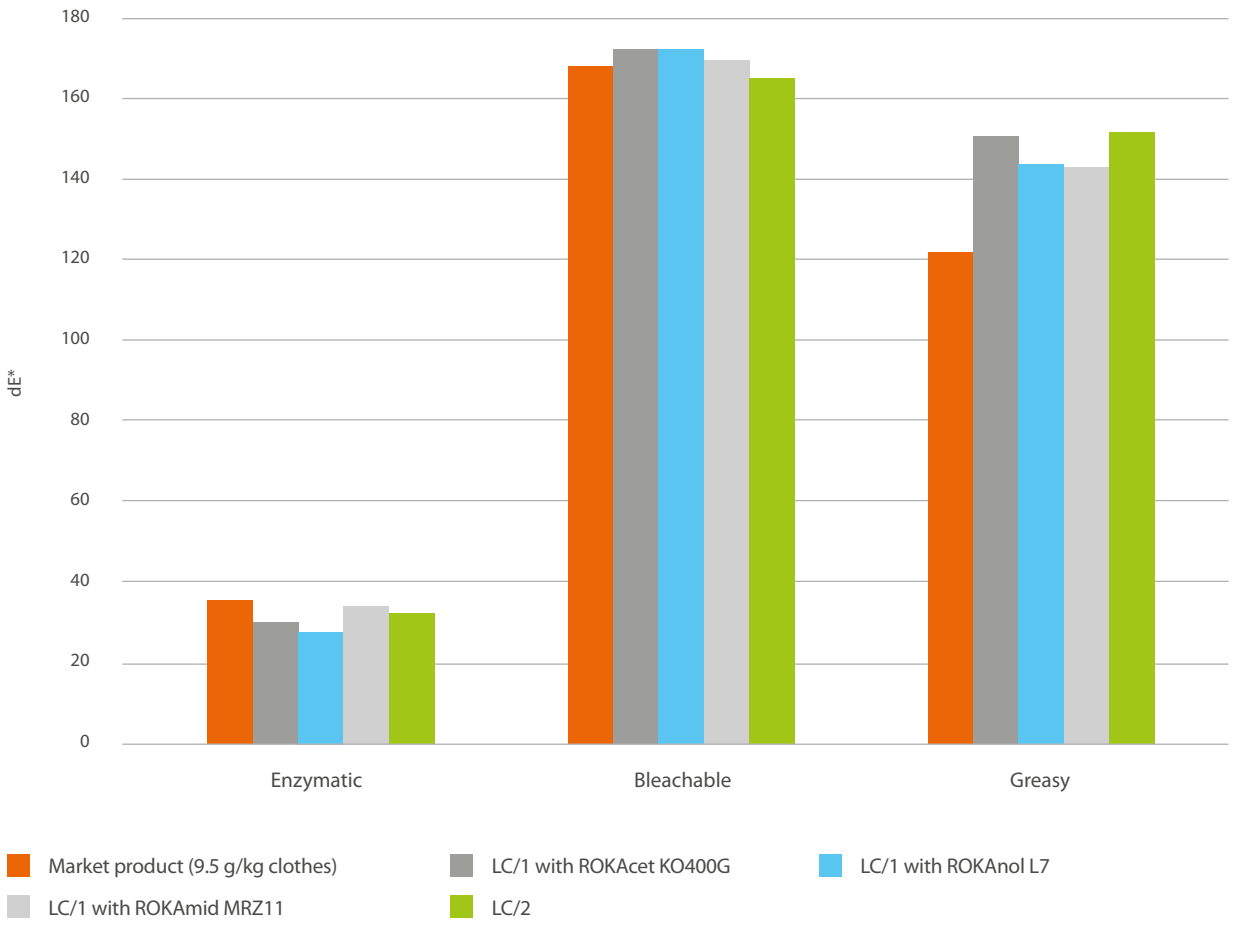
| Compound | Brand name | Concentration [%] | Function |
|---|---|---|---|
| **MIPA Laureth Sulfate (and) Propylene Glycol** | **SULFOROKAnol L290/1M/ SULFOROKAnol L390/1M** | **40.00** | **Removes stains/ wetting agent** |
| **PEG-6 Glyceryl Cocoate** | **ROKAcet KO400G** | **17.00** | **Removes stains** |
| **Laureth-7** | **ROKAnol L7** | **15.00** | **Removes stains** |
| Glycerin | – | 17.95 | Humectant |
| Tetrasodium Glutamate Diacetate | – | 4.00 | Chelator |
| Enzymes | – | 1.00 | Breaks down different types of stains |
| Fluorescent brightener | – | 0.05 | Optical brightener |
| Sodium Hydroxide | – | for pH ~ 8 | pH regulator |
| Aqua | – | 5.00 | Solvent |

| | | |
|---|---|---|
| **Appearance** | visual method | gel |
| **pH** | | 7.5-8.0 |
| **Viscosity [cP]** | Brookfield LV, T: 20°C | 600-900 |
| **Water content [%]** | Karl Fischer method | <10 |

## Procedure:

**1.** Mix Fluorescent brightener with water until dissolved.
**2.** Add Glycerin and GLDA-$Na_4$, mix.
**3.** Add ROKAcet KO400G and mix.
**4.** Then add ROKAnol L7, mix.
**5.** Then add SULFOROKAnol L290/1M/SULFOROKAnol L390/1M and mix.
**6.** Add Sodium Hydroxide to obtained pH in the mass around 8.
**7.** Finally, add Enzymes and mix.

## Laundry Capsules (8 g/kg clothes)




Parameter dE* is the difference between the initial stain and the degree of its washing, higher dE*, better detergency.

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