# I Filtri Solari
# INORGANICI

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WORKSHOP SOLARI
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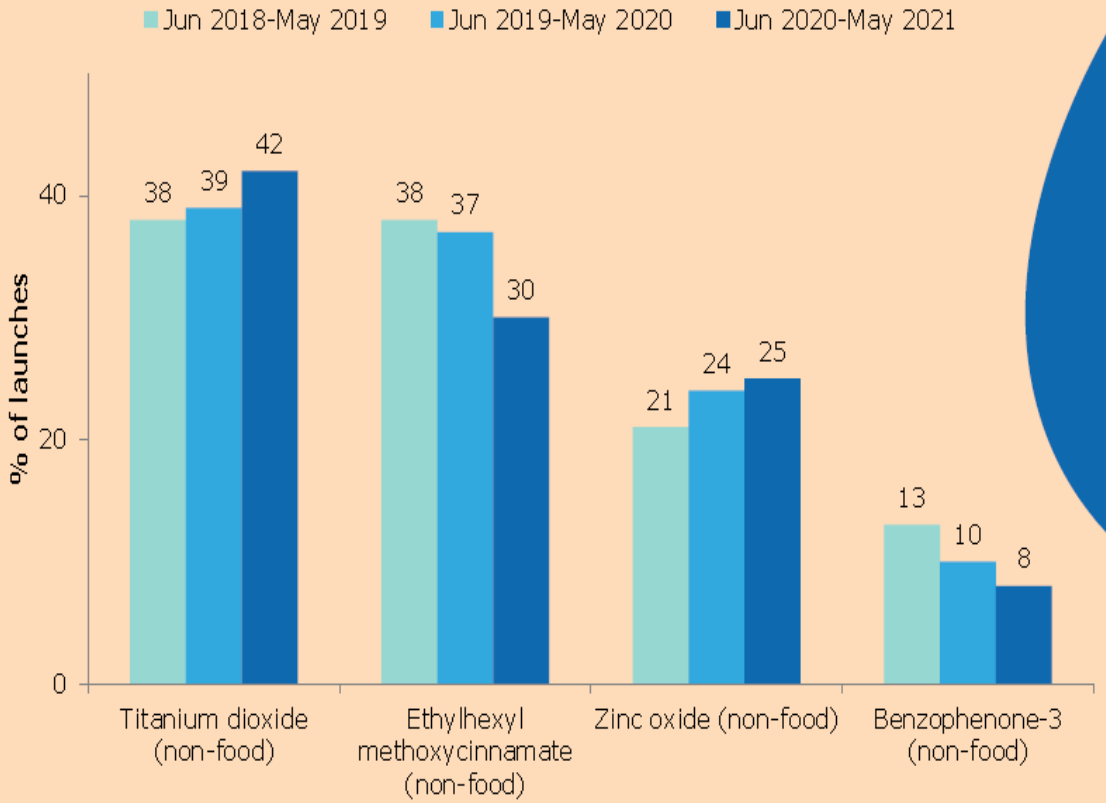
# Mineral suncare launches 2018 - 2021

**Global: percentage of each active ingredient in new suncare launches, 2018-21**




*Source: Mintel GNPD, June 2018-May 2021*

"Global brands... focus on mineral suncare as consumer demand for clean ingredients rise and reef-safe claims grow. Potentially harmful chemical actives are decreasing in new suncare launches, while greenlit mineral actives grow." (Mintel)

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**Efficaci,** fotostabili e **ampio spettro**
≥ 2.0 in vivo SPF / % uso
~ 0.3/0.9 in vivo UVA PF / % uso

- **non penetrano** , ottima **compatibilità con la pelle**

Elevata **trasparenza** anche ad altre concentrazioni
Disperdibili in **Acqua e/o Oli**

**Filtri UV Globali** approvati in tutto il mondo ( GRASE US)

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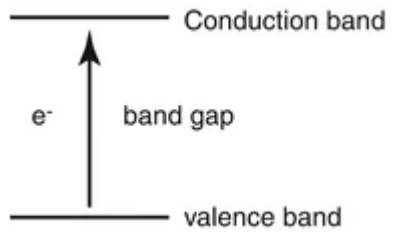
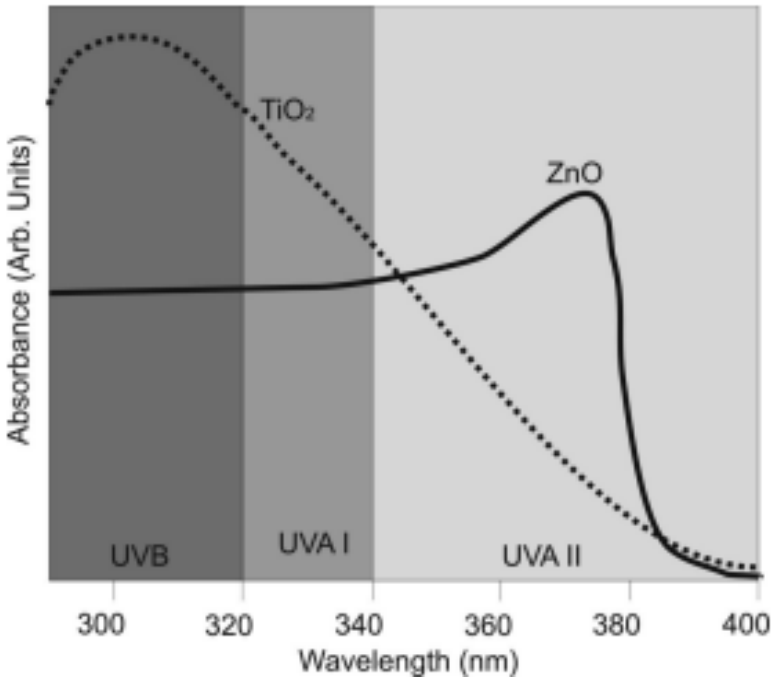



- The two inorganic UV filters interact with UV light by two mechanisms: absorption and reflection/scattering.
- Both ZnO and $TiO_2$ are semiconductor materials that allow light to be absorbed.
- In fact, approximately 85 to 95 percent of UV radiation is actually absorbed by inorganic UV filters (Cole et al., 2016).
- Similar to organic UV filters, UV radiation excites an electron into a higher energy orbital state (Smijs and Pavel, 2011).
- Specifically, overlapping electron orbitals in the crystalline structure form "bands," with gaps between energy bands ("band gap").
- Electrons are excited across the band gap from a lower valence band into a higher conduction band.
- Particle size and composition influences the amount of UV radiation that is absorbed or scattered/reflected.

- Larger particles reflect/scatter more UV radiation than smaller ones, though for all particles absorption is still a dominant mechanism.

- Smaller, nanoscale particle UV filters reflect less visible light, and therefore appear nearly transparent in color, compared to the whiter appearance of larger particles. Reducing particle size also shifts the UV wavelength range that the particles are protective against

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**Assorbimento**

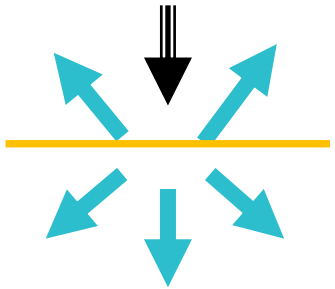
**UV-rays** electronic excitation energy → **UV Filter** → **Heat** vibrational energy transferred to environment

**Valid for :**

**organic and inorganic UV filters**

**Riflesso**

**Scattering/Diffusione**



**inorganic UV filters**

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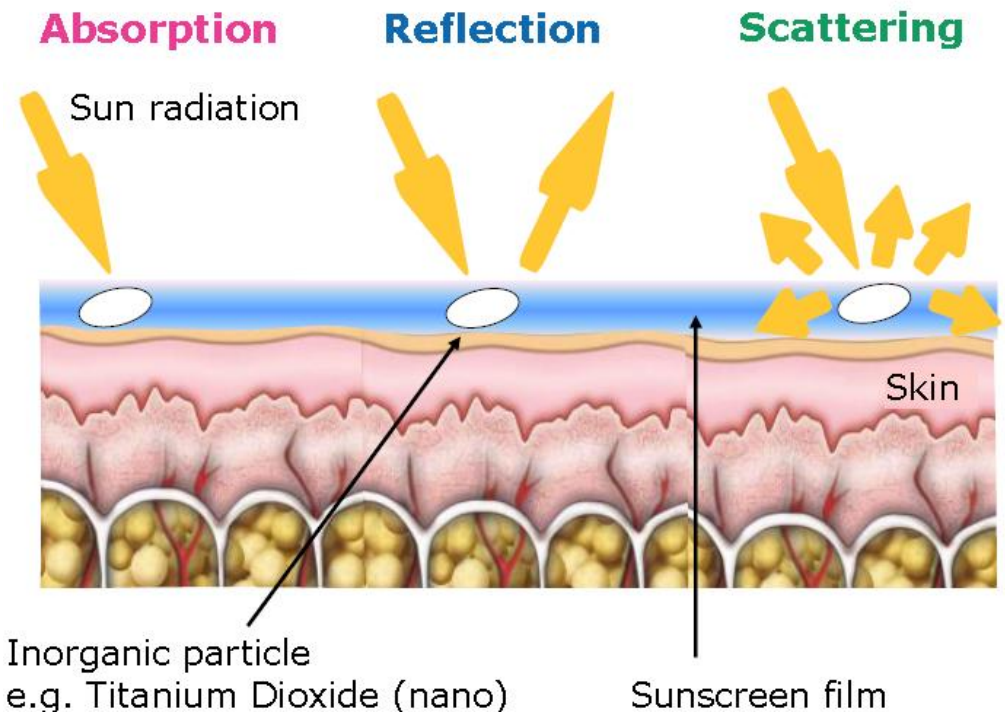


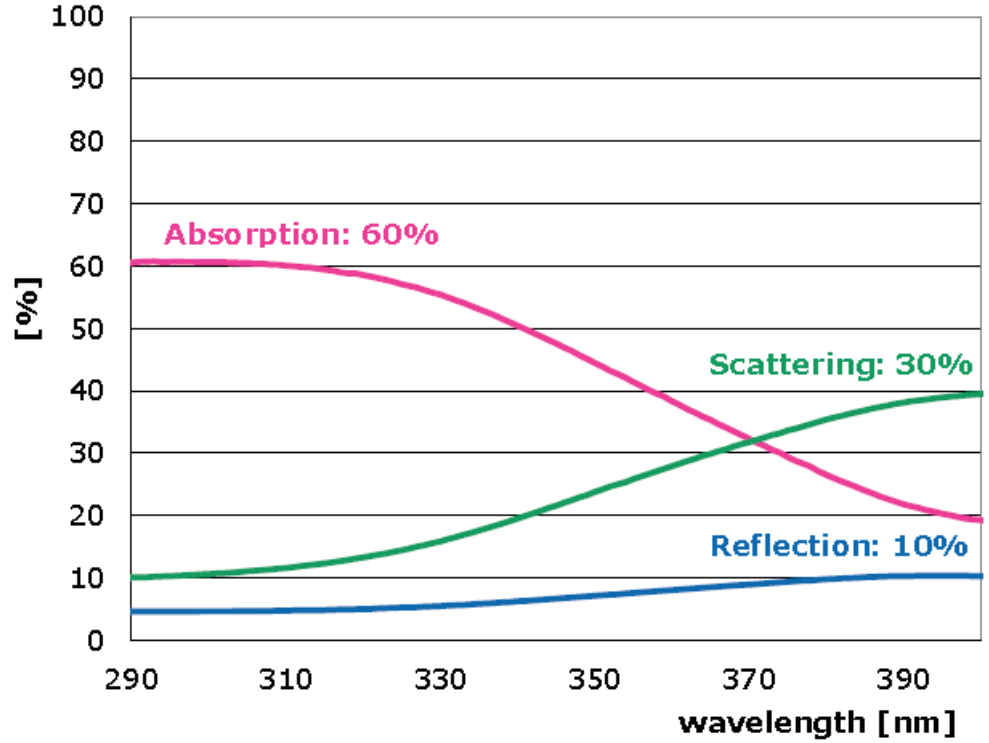


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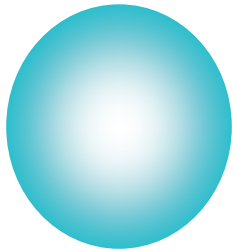
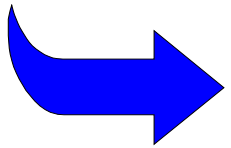
**Pigment**





**Microfine particle, “nano”**

**Down-Scaling**

- **Crucial influence on**

- light scattering / whiteness on skin
- absorption of UV radiation and efficiency
- specific surface
- surface coverage on skin
- dispersibility
- flocculation stability

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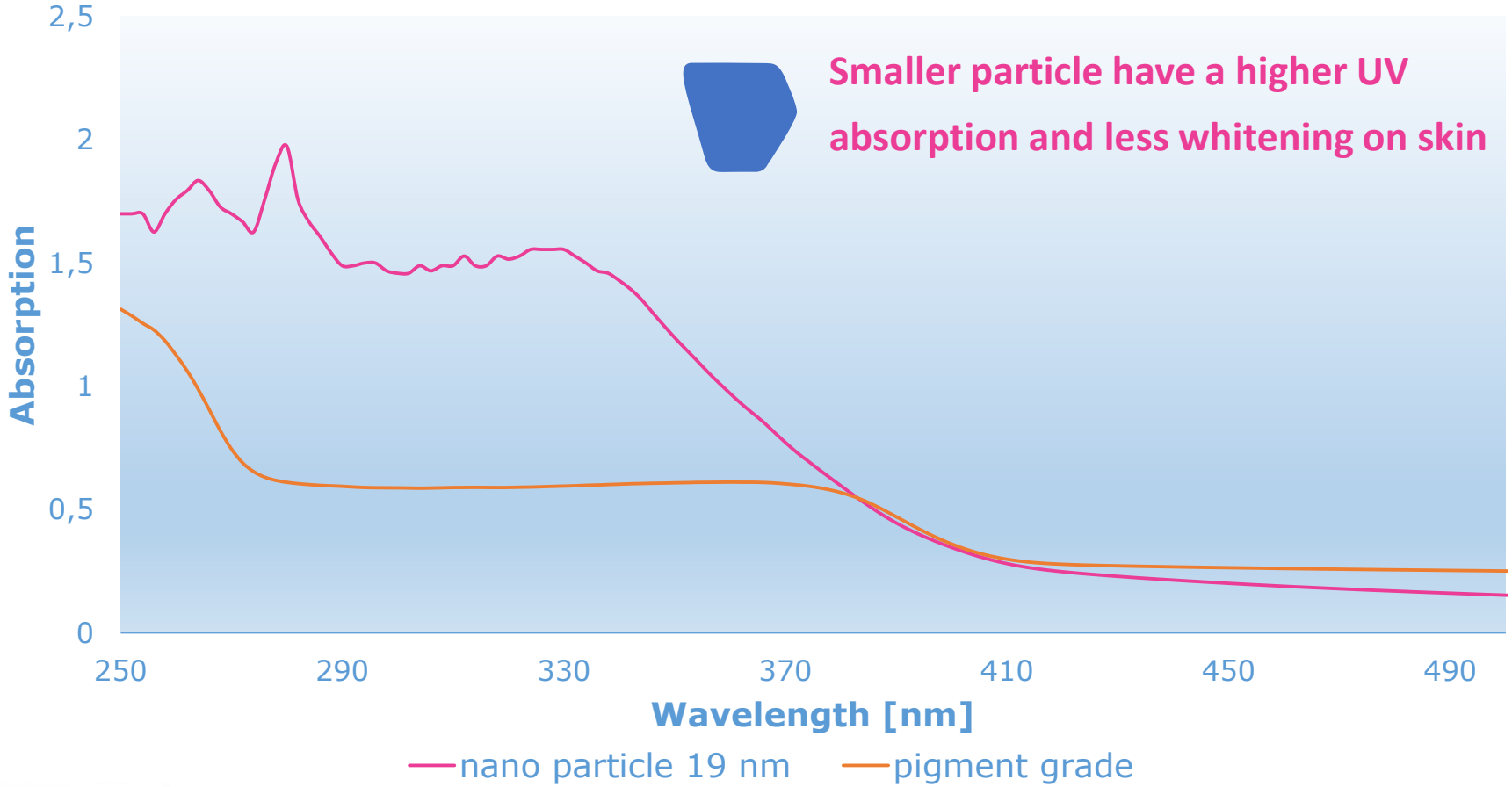


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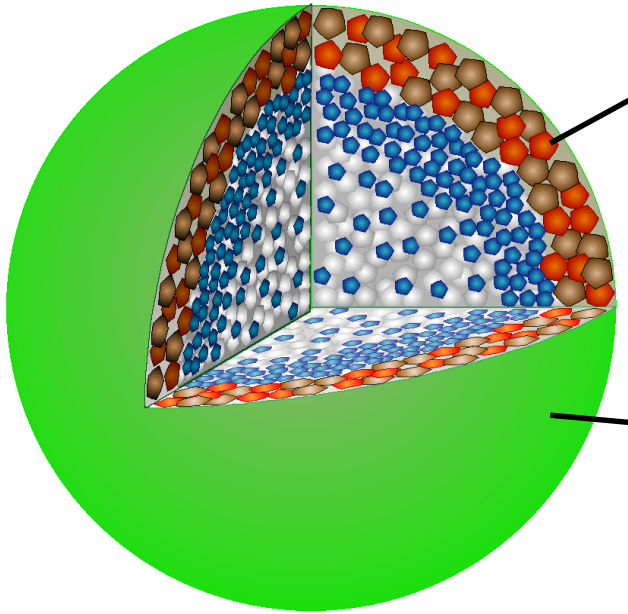

**Inorganic Coatings**

- Alumina
- Silica
- Manganese Dioxide
- Sodium Metaphosphate
- …

**Organic Treatments**

- Stearic Acid
- Glycerin
- Dimethicone, Hydrogen Dimethicone, Simethicone
- Tri(m)ethoxycaprylylsilane
- Cetyl Phosphate
- …

**Adjustment of specific surface to induce**:

- passivation
- dispersability in media
- flocculation stability etc.

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| $TiO_2$ Crystalline Form | Coating Material* | Doping Material | Form | Bulk density ($g/cm^3$) | VSSA ($m^2cm^{-3}$) |
|---|---|---|---|---|---|
| > 98 % Rutile, < 2 % Anatase | 16 % Silica, 6 % Cetyl Phosphate | None | Hydrophobic powder | 0.2 | 150 |
| > 95 % Rutile, < 5 % Anatase | 7 % Alumina, 0.7 % MnO2 | 1000 ppm Fe | Hydrophilic powder | 0.16 | 370 |
| 100 % Rutile | 3 % Alumina, 9 %Triethoxycaprylylsilane | None | Hydrophobic powder | 0.48 | 95 |

| Material code | TiO2 crystaline form | Coating material | Doping material | Form | Bulk density (g/cm3) | VSSA (m2 cm-3) |
|---|---|---|---|---|---|---|
| S75-A | > 99.5% Rutile | 6% silica, 16% alumina | None | Oil dispersion | 0.35 | 460 |
| S75-B | > 99.5% Rutile | 6% silica, 16% alumina | None | Aqueous dispersion | 0.35 | 460 |
| S75-C | > 99.5% Rutile | 7.5% alumina, 9,5% aluminium stearate | None | Oil dispersion | 0.31 | 220 |
| S75-D | > 99.5% Rutile | 10% alumina, 13.5% stearate | None | Oil dispersion | 0.58 | 300 |
| S75-E | > 99.5% Rutile | 10% alumina, 13.5% stearate | None | Aqueous dispersion | 0.58 | 300 |
| S75-F | Anatase 85%, Rutile 15% | 7.5% trimethoxycaprylylsilane | None | Hydrophobic powder | 0.2 | 192 |
| S75-G | Anatase 85%, Rutile 15% | None | None | Hydrophilic powder | 0.13 | 213 |
| S75-H | > 99,5% Rutile | 6% alumina, 1% glycerin | None | Hydrophilic powder | 0.31 | 260 |
| S75-I | > 99,5% Rutile | 7% alumina 10% stearic acid | None | Hydrophobic powder | 0.28 | 300 |
| S75-J | > 99,5% Rutile | 6% alumina 1% dimethicone | None | Hydrophobic powder | 0.31 | 260 |
| S75-K | > 94% Rutile | 6-8% aluminium hydroxide, 3.5-4.5% dimethicone/methicone copolymer | None | Hydrophobic powder | 0.12-0.28 | 426 |
| S75-L | > 94% Rutile | 6.5-8.5% hydrated silica, 2.5-4.5% aluminium hydroxide, 4.5-6.5% dimethicone/methicone copolymer | None | Hydrophobic powder | 0.07-0.2 | 426 |
| S75-M | > 98% Rutile, <2% anatase | 17% silica | None | Hydrophilic powder | 0.09 | 260 |
| S75-N | > 95% Rutile, <5% anatase | Alumina 10% simethicone 2% | 1000 ppm Fe | Amphiphilic powder | 0.16 | 400 |
| S75-O | 100% Anatase | Simethicone 5% | None | Hydrophobic powder | 0.75 | 400 |

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  - Informazioni utili

**Caution** if you adapt existing formulations, difficulties may arise (instability, change in viscosity, …):

- when changing the **load of $ZnO/TiO_2$**
- when **replacing** an inorganic filter by another grade having a different coating and herewith different product properties

- **Use appropriate level of emulsifiers** (adsorption of emulsifiers on $TiO_2$ surface)
- **Non ionic emulsifiers** are to be preferred
  (interaction of $TiO_2$ with ionic emulsifiers can not be totally excluded)

- Ensure a **good dispersion** of the inorganic filter in the formulation - use dispersing aids if necessary - and check homogeneity by **microscopic examination**
- Needed **energy input** depends on the **$ZnO/TiO_2$ type** and **coating**
- ZnO may lead to **pH change** in formulation during storage
- Emulsions of low viscosity: Use stabilization systems to avoid sedimentation, e.g. **microcristalline cellulose**

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**o/w formulations**

| | |
|---|---|
| Glyceryl Stearate & PEG 100 Stearate | (e.g.Arlacel165) |
| Steareth-10, Steareth-7, StearylAlcohol | (e.g.Emulsifier E 2155, Volpo-S10…) |
| Hexadecyl-& octadecylglucoside + Cetyl/stearylalcohol | (e.g.EmulgadePL 68/50) |
| Polyglyceryl-3 MethylglucoseDistearate | (e.g.TegoCare 450) |
| Sodium CetearylSulfate, CetearylAlcohol, PEG-40 Castor Oil | (e.g.EmulgadeF) |
| DimethiconeCopolyolPhosphate | (e.g.PecosilPS-100) |
| Phosphate based emulsifiers | (e.g.AmphisolK, Emulsiphosor Crodafos) |

**w/o and w/siformulations**

| | |
|---|---|
| PEG-30 Dipolyhydroxystearate | (e.g.ArlacelP135 for w/si, w/o & w/si-o) |
| Polyglyceryl-4-Isostearate & Cetyldimethiconecopolyol& Hexyl Laurate | (e.g.AbilWE 09) |
| Lauryl methiconecopolyol | (for w/si) |
| Cyclomethicone& Dimethiconecopolyol | (for w/si) |

**Disperdenti**

CetylDimethicone, PolyhydroxyStearic Acid, Polyglyceryl-3 Polyricinoleate

**Filmanti**

PVP/EicoseneCopolymer, TricontanylPVP

**Viscosizzanti**

Xanthan Gum (0.1 –0.3%)

Carbomers/ Acrylate based copolymers(without agglomeration generally 0.1% possible)

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Metal oxides, $TiO_2$ or ZnO in combination with Carbomers in formulations can cause Aggregated structures or inelegant textures („cottage cheese" effect)

**Strategies to avoid Carbomer-$TiO_2$agglomerates:**

Use of low concentrations Xanthan Gum (0.1 –0.3%) in the water phase to achieve small droplets and / or Stabilize the produced emulsion at 35 –40°C by means of a Carbomer-Pemulen/ oil phase dispersion (0.1 –0.2% Carbomer/ Pemulen) and additional homogenizer step Or use **Silica Coated $TiO_2$**

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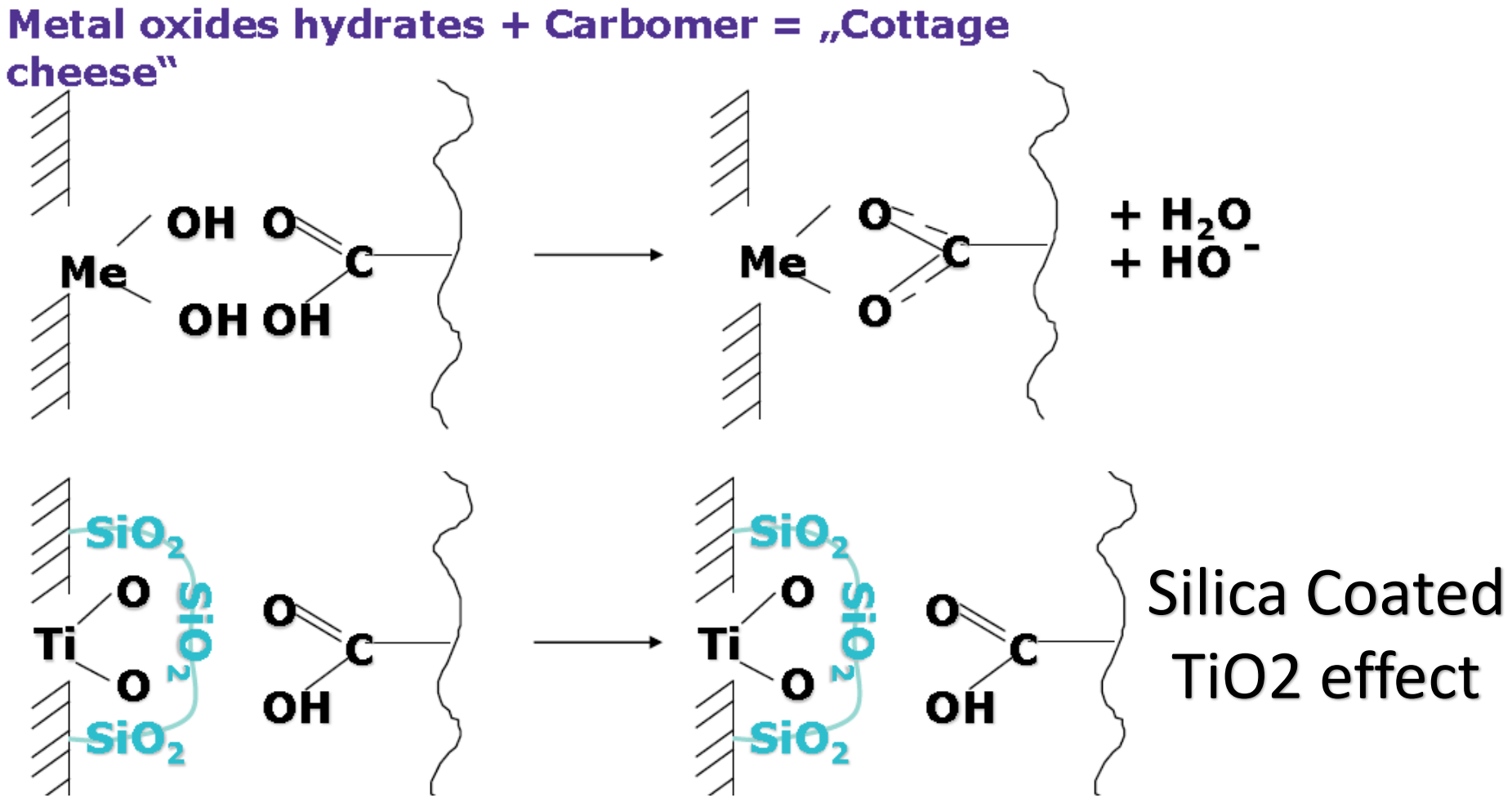


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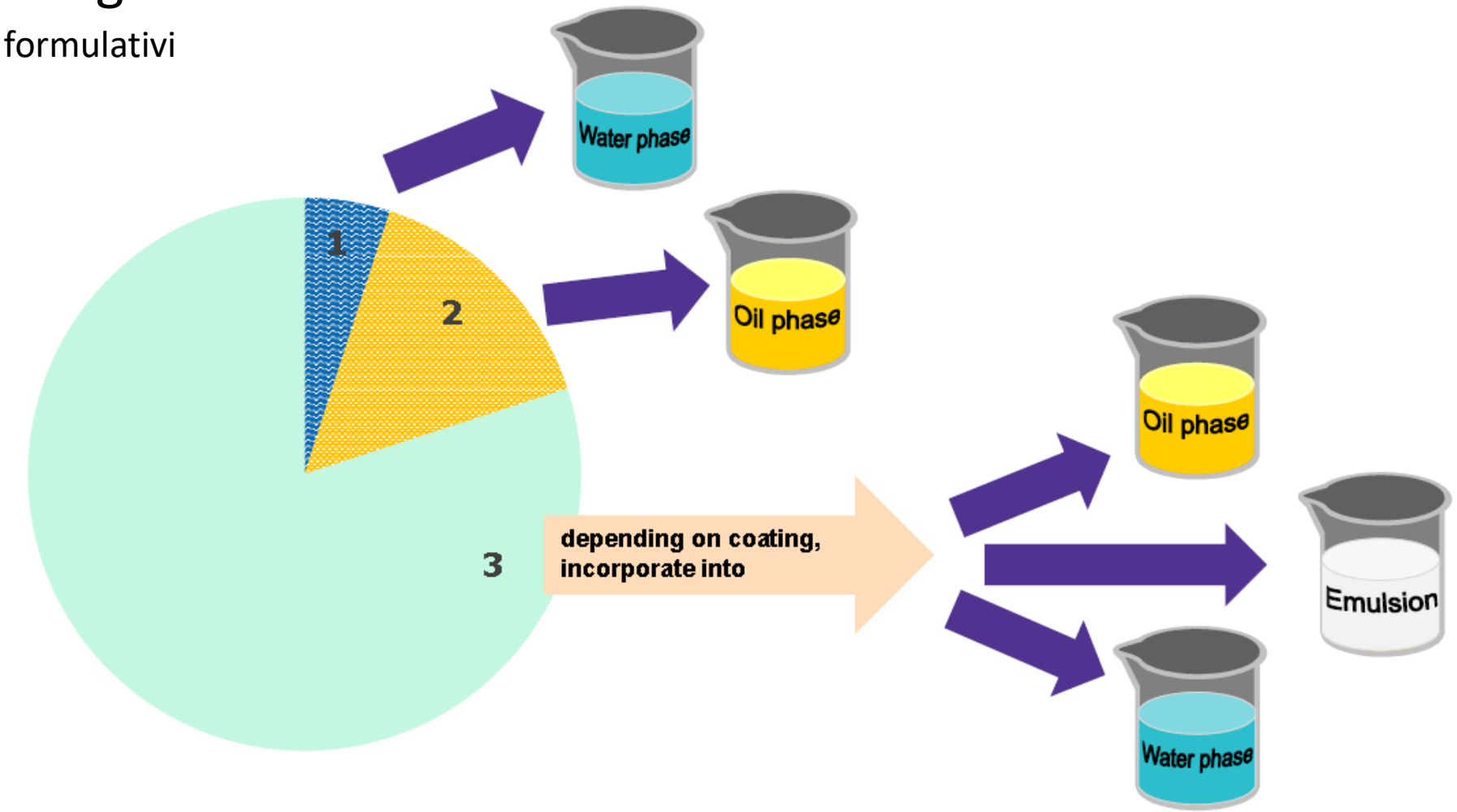



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