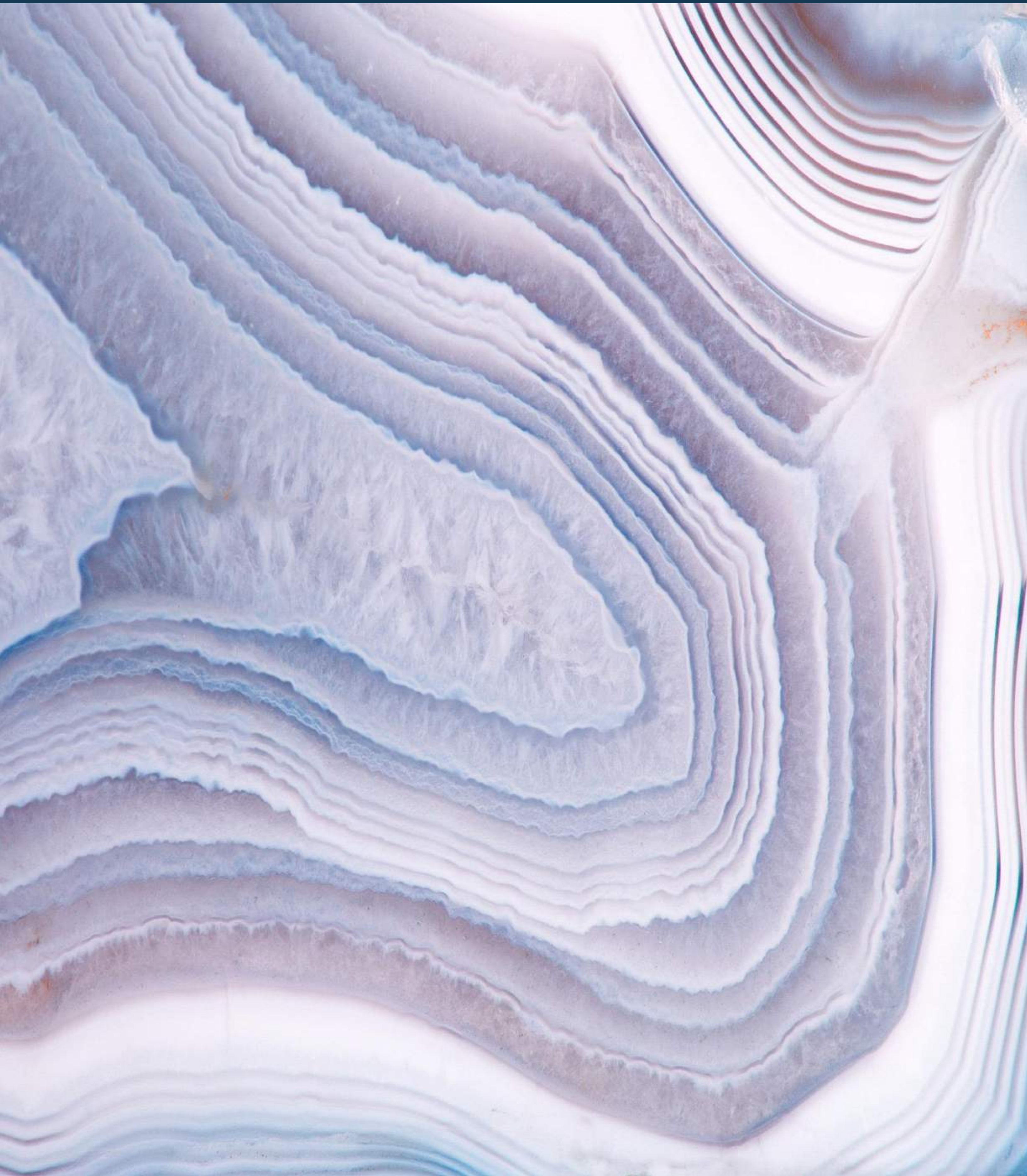
# Talc As Anti Block For PP Films



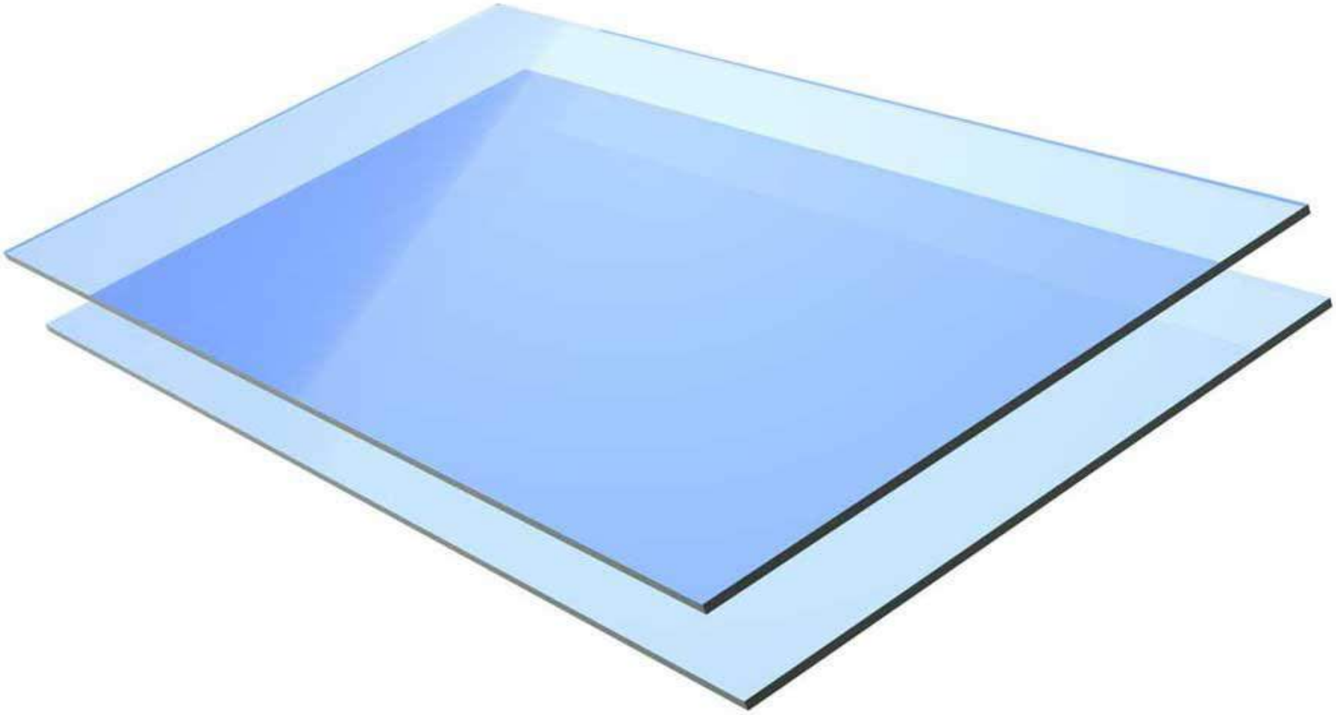
## 1.0 Introduction

Blocking is a common problem encountered by manufacturers of polyolefin films and coatings. There are different types of antiblock available. This report describes benefits & reasons for choosing the most suitable antiblock additives.

Blocking is the adhesion of two adjacent layers of film. It is a problem most associated with polyethylene and polypropylene films (either blown or cast), and to a lesser extent in extrusion coated or laminated products.

Blocking of adjacent film layers occurs due to the presence of Van der Waal's forces between the amorphous regions of the polymer. These forces increase with reduced distance between the two layers, thereby increasing blocking when two layers are pressed together (e.g. winding onto a take up roll or stacking of finished, converted films).

The most effective method for combating these handling issues is to add an antiblock additive. An antiblock additive present in the resin microscopically protrudes from the film surface. This creates "little protrusions", which help to minimize the film-to-film surface contact, increasing the distance between the two layers, thereby minimizing blocking.



## 2.0 Antiblock Additives

Commercially important antiblock additives can be broken down into inorganic and organic types.

### 2.1 Inorganic Additives

These are non-migratory additives useful for high temperature applications since they melt at much higher temperatures than typical polyolefin extrusion temperatures. The particle size and shape of the additive & quality of dispersion plays a key role in determining its antiblocking efficiency. Proper selection of additive type depends somewhat on the gauge (thickness) of the film.

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|---|---|---|
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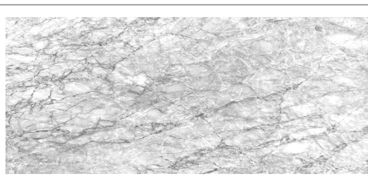
|  |  |  |

| Types | Chemical description | Process |
|---|---|---|
| Natural Silica | Silicon Dioxide | Mined |
| Talc | Magnesium Silicate | Mined |
| Synthetic Silica | Synthetic silica | Manufactured |
| Calcium Carbonate | Calcium carbonate | Mined |
| Ceramic microspheres | Aluminium silicate spheres | Manufactured |
| Kaolin Clay | Aluminium silicate | Mined |
| Mica | Aluminium Potassium silicate | Mined |

*Products highlighted in blue are offered by Polymer Add Pte Ltd.*

Inorganics additives are relatively inexpensive and best positioned for large volume, commodity-like applications.

### 2.2 Organic Additives

Organic antiblocks are migratory in nature and are thought to crystallize on the film surface, forming interfering layers between the adjacent film layers. Organic antiblocks are of used mostly in high clarity films and cling films. In general organic additives are more costly and hence used in high value applications.

### 2.3 Organic Anti Blocks

| Type | Examples |
|---|---|
| Bis-Amide | Ethylene Bis Stearamide ( EBS) |
| Primary Amide | Stearamide, Erucamide |
| Secondary Amide | Stearyl Erucamide |
| Organic Stearates | Glycerol Mono stearate ( GMS 90%) |
| Metal Stearates | Zinc Stearate, Aluminium Stearates |
| Others | Silicon, PTFE |

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## 3.0 Fundamental Properties

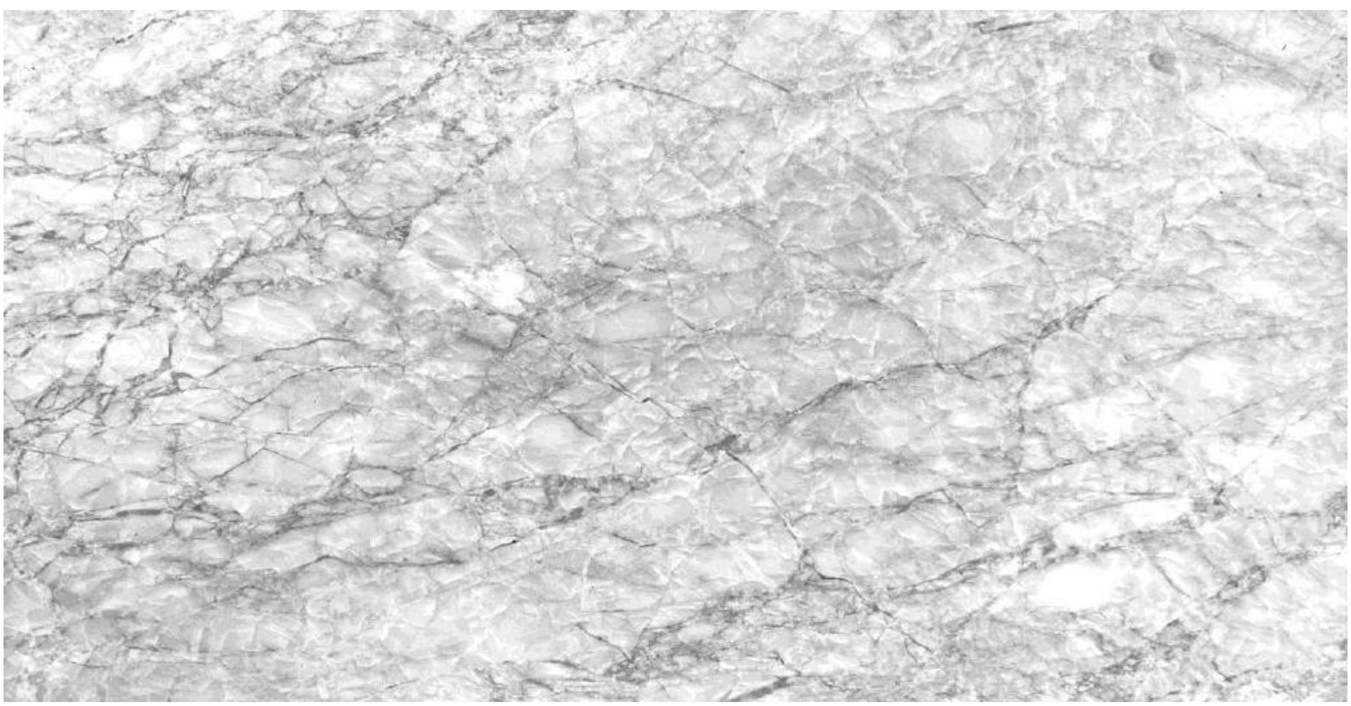
### 3.1 Shape

As a thumb rule, the more irregular the shape, the more effective an inorganic particle in its antiblock properties. Uniform spherical shapes should are considered least efficient in maximizing the number of protuberances or microscopic mechanical surface imperfections so their anti block properties are considerably reduced.

Natural & synthetic silica and talc along with Kaolin / clay and Mica, therefore, appear to be best suited for efficient anti-blocking given their irregular shapes.

| **Type** | **Particle size** D50 microns | **Shape** | **Colour** |
|---|---|---|---|
| Natural Silica | 4-8 µ | Angular, Irregular | Yellowish white to grey |
| Talc | 2-5 µ | Platy | White to Yellow |
| Synthetic Silica | 4-5 µ | Irregular | White |
| Calcium Carbonate | 2-3 µ | Spherical | White to Yellowish |
| Ceramic Spheres | 4-7 µ | Spherical | White, gold, grey |
| Kaolin / Clay | 2-4 µ | Platy, Hexagonal | White |
| Mica | 4-8 µ | Platy | Pearlescent, white, to grey |

*During trials using 4 different additives, Natural Silica, Synthetic Silica, Talc, and Calcium Carbonate it was found that irregularly shaped Silica and Talc outperform the smaller, more spherical particles of Calcium Carbonate.*
*In addition, much higher dosage levels of 250-300% are required to achieve performance equivalent to Silica or Talc. Higher dosage of antiblock will increase haze (reduce clarity) as well as change the physical properties of the film.*



## 3.2 Chemical properties & Iron content

Other important parameters when choosing the correct source of antiblock is their chemical inertness, (Acid resistance, Alkali resistance), Mohs hardness and presence of chemical impurities.

| Property | SiO2 | Talc | CaCO3 |
|---|---|---|---|
| SiO2 content | 93% | 60-65% | < 1% |
| MgO content | < 1% | 31% | < 1% |
| Fe2O3 content | 1-3% | < 1% | < 1% |
| Acid resistance | Good | Good | Poor |
| Alkali resistance | Good | Good | Fair |
| pH | 10 | 9 | 9.5 |
| Mohs Hardness | 7-8 | 1 | 3 |
| Specific Gravity | 2.3 | 2.8 | 2.7 |

*Areas highlighted in orange could be potential problem areas for converter.*

**High iron content** usually creates problems of colour of the film due to its probability to oxidise quickly and its reactivity with organic acids and bases. Higher iron oxide content can also speed up degradation of organic components present in the films (such as slip/antistat additives) it can also degrade the base resin. Aged films with higher iron content can exhibit odor or rancidity due to iron component which has reacted with the other additives.

### 3.3 Refractive index

Refractive index differences between inorganic particles and the surrounding polyolefin determine the additives impact on clarity or haze. **Haze is lower as the refractive index of the additive approaches that of the polymer.** For some film applications this may be of importance.

| Product | Refractive Index nα | | Target | %Deviation | %Deviation |
|---|---|---|---|---|---|
| | Lower Limit | Upper Limit | Index | Lower | Upper |
| Polypropylene film | 1.492 | 1.492 | 1.492 | 0 | 0 |
| (for a film of 12.71-micron thickness and 0.9049g/cm3 density) | | | | | |
| Natural Silica ((Silicon dioxide, Silica, Quartz) | 1.457 | 1.558 | 1.492 | -2.35 | 4.42 |
| Synthetic Silica | 1.457 | 1.558 | 1.492 | -2.35 | 4.42 |
| Talc | 1.538 | 1.55 | 1.492 | 3.08 | 3.89 |
| Mica | 1.56 | 1.657 | 1.492 | 4.56 | 11.06 |
| Calcium Carbonate | 1.64 | 1.66 | 1.492 | 9.92 | 11.26 |
| Ceramic Spheres | 1.934 | 2.134 | 1.492 | 29.62 | 43.03 |

*Much more consistent results*

As you can see, Pure, Natural Silica, Synthetic Silica and Talc can perform much better than in clear films due to their relative nearness of their refractive index to that of the film.

### 3.4 Specific gravity

Specific gravity can improve the film yield for the film producer. As denser materials are added to in dosage of less than 1% in base polymer, the throughput increases in terms of (kg/hr), (if film gauge is held constant, a given area of film will weigh more).

## Conclusion:

Natural & Synthetic Silica and Talc prove to be the most efficient antiblocks in standard film application, with Talc being the anti block of choice, due to its lowest cost/performance ratio. Synthetic Silica is preferred due to less inorganic impurities and improvement in haze.

### Information on Test Methods

The standard method for testing blocking between layers of plastic film is ASTM 3354-89. By this method, the film-to-film adhesion is expressed as the load (in grams) required to separate the two layers of polyethylene film. The test is limited to a maximum load of 200 grams. This is measured by a balance-beam type system similar to an analytical balance. One sheet of film is attached to a block suspended from the end of the balance beam. The other sheet of film is attached to a block fastened to the balance base. Weight is added equivalent to 90 + 10 g/min to the other side of the beam until the two films fully separate, or until they reach 1.905 cm separation.

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