

# The Function of Anti-Skinning Agents and Anti-Oxidants in Coatings

## FEATURING ADDITIVE OPTIONS

### AGING - CAUSE AND EFFECT

Every material undergoes a continuous change in its properties due to molecular processes caused by:



Light



Heat



Oxygen



Ozone



Moisture



Trace Metals



High-Energy Radiation

This process is called aging.

**Stabilizers (Anti-Oxidants)** can be used to delay the aging process.

Some of the technical fields of application for **Anti-Oxidants** and the processes they prevent are:



**Plastics + rubber**  
(aging, embrittlement)



**Fat & grease** (rancidness)



**Oils and petroleum spirits**  
(gumming and sludge formation)

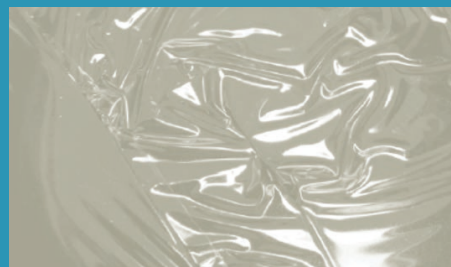


**Coating materials** (skinning)

### Skin formation on coatings is a symptom of the chemical aging of materials.

Oils and binders that undergo oxidative crosslinking by reaction with oxygen, and as a result form a solid polymer film, may undergo surface skin formation during storage.

Therefore, in air-drying systems, skinning is caused by the premature, undesirable crosslinking of the binder at the atmospheric interface (surface) under the influence of oxygen in the air.



Skin formation in a coating

# THE FUNCTION OF ANTI-OXIDANTS

Anti-oxidants (or anti-skinning agents) are used to prevent skin formation in air-drying coating systems that contain driers as accelerators. These are usually organic compounds that inhibit or delay the undesirable oxidative processes caused by the influence of oxygen during storage.

A distinction is made between **two different mechanisms of action**:

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- 6 HIGH-PERFORMANCE CATALYSTS

1

### Use of radical interceptors

Radical interceptors scavenge reactive oxygen species that are formed when atmospheric oxygen diffuses into the binder. Phenolic antioxidants (preferably sterically hindered ones) are generally used for this application.

2

### Use of complexing agents / metal ion deactivators

Complexing of the siccative metal with organic complexing agents causes a temporary deactivation of the catalytic center. Some nitrogen-based anti-skinning agents are suggested to act in this way.

### Borchers brand names

Borchers offers compounds for different applications under the brand names:

**ASCININ®**  
**BORCHI® NOX**  
**BORCHI® SHIELD**

1

2

3

4

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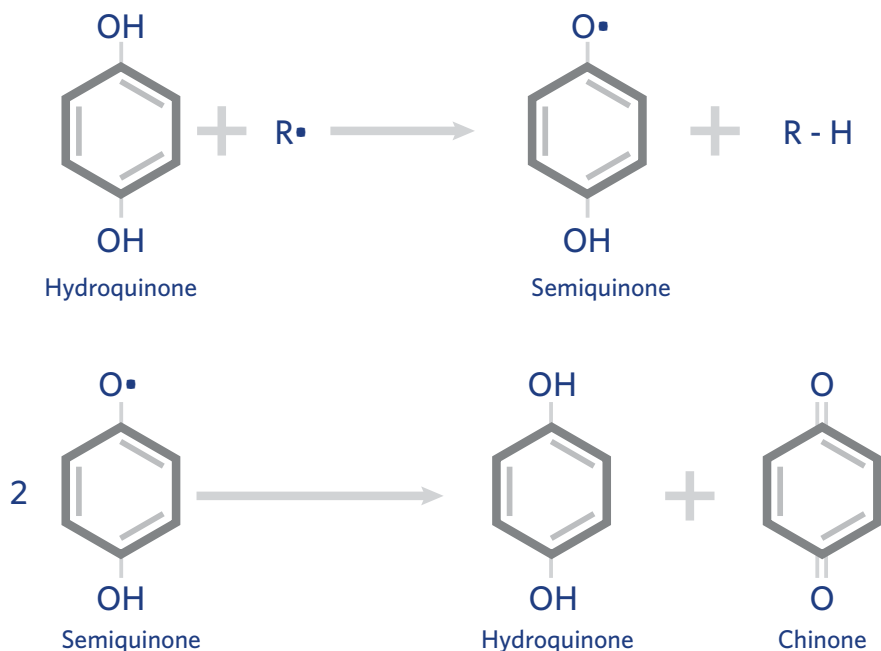
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## RADICAL INTERCEPTORS

Radical interceptors react with the free radicals formed during auto-oxidation (e.g.,  $R^\bullet$ ,  $R-O^\bullet$ ,  $R-OO^\bullet$ ) and deactivate them.

### Hydroquinone: a simple example

Sterically hindered phenolics can, in addition to transferring a hydrogen atom, also bind the resultant peroxy radicals  $R-OO^\bullet$ .



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A typical feature of phenolic anti-oxidants is that, being genuine oxygen inhibitors, they have very good anti-skinning effects. However, due to their generally low vapor pressure, they also have low volatility and, therefore, may delay the drying of a coating to an undesirable extent. Correctly metered and applied, they regulate shelf life, drying, and film hardness.

## Metal ion deactivators

Metal ions that can be reversibly oxidized by atmospheric oxygen, and are present in several stable oxidation stages, can accelerate film formation and curing in oxidatively drying binder systems. In this case, these "pro-oxidants" are used specifically as driers for catalysis. By addition of suitable complexing agents, it is possible to make these catalysts temporarily ineffective by masking them as oxygen carriers during storage; this can be achieved by converting the metal siccatives into complex compounds that have no or weak drying properties – however, the resulting complex compounds must be quite unstable.

After application of the coating, they will quickly break down by evaporation of the complexing agent, and catalytic crosslinking can take place. Complexing agents do not interfere with the auto-oxidation mechanism.

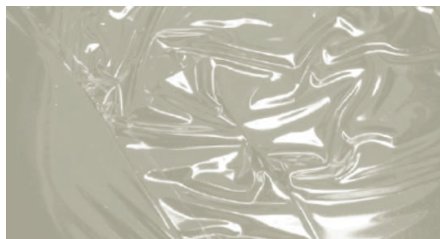
## Synergism

Synergism is given if the effect of a mixture of substances exceeds the sum of their individual effects. Generally speaking, synergists enhance the desired effect in the coating system. Highly effective anti-oxidants can be produced by combining a radical interceptor with a metal complexing agent. However, the anti-oxidative effect can also be improved by further measures, such as additional combination with UV stabilizers.

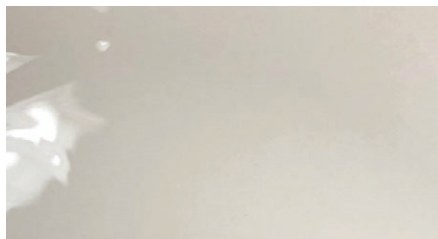
# PRODUCT OVERVIEW

**Borchi®** and **Ascini®** are the product names of anti-oxidants and anti-skinning agents that we produce and market for all types of oxidatively drying coating systems.

## Anti-skin performance



without anti-skinning agent



with Borchers anti-skinning agent

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Product	Chemistry	Application	Description	Dosage*
<b>Ascini®</b> <b>Anti-Skin 0444</b>	Amino compound dissolved in 1,2-propanediol	Solventborne high solids formulations, printing inks, clear coats, and pigmented coatings	Phenol- & MEKO-free. Controls surface dry retardation and keeps the film open longer to ensure deeper penetration of oxygen to lower film layers which promotes through dry and improves flow properties in solventborne systems.	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
<b>Ascini®</b> <b>Anti-Skin 0445</b>	Amino compound dissolved in fatty acid ester	Waterborne and solventborne clear coats and pigmented coatings	Phenol- & MEKO-free. Controls surface dry retardation and keeps the film open longer to ensure deeper penetration of oxygen to lower film layers which promotes through dry and improves flow properties in waterborne and solventborne systems.	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
<b>Ascini®</b> <b>Anti-Skin 1240</b>	Amino compound dissolved in fatty acid ester	Solventborne clear coats and pigmented coatings	MEKO-free and reduced VOC content. Specially designed for oxidatively drying coatings systems and pastes. Higher volatility than Ascini® Anti-Skin 0444 and 0445.	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
<b>Borchi®</b> <b>Nox C3</b>	Cyclohexanone oxime	Solventborne printing ink formulations	Readily soluble and easy to incorporate. Does not cause any discoloration. Enhances gloss and flow properties of air-drying systems.	0.5 - 2.0%
<b>Borchi®</b> <b>Nox 1640</b>	Cyclohexanone oxime	Solventborne paint formulations	MEKO-free. Does not cause discoloration or adversely affect the drying time of the paint system. Higher volatility than Ascini® Anti-Skin 0444 and 0445.	0.2 - 1.5%
<b>Borchi®</b> <b>Nox M2</b>	Methyl ethyl ketoxime	Solventborne	Delays the onset of drying for clear lacquers without affecting through drying. Prolongs the open time of the film, thereby preventing flow problems and blistering. Only available in Asia and EMEA regions.	0.2 - 1.0%
<b>Borchi®</b> <b>Shield</b>	Amino / oxime compound dissolved in fatty acid ester	Solventborne high solids formulations	MEKO-free. Works in high solids, long oil alkyds to improve storage stability, control surface dry retardation, and help keep the film open longer to ensure deeper penetration of oxygen.	0.2 to 1.5%

\*dosages can be higher or lower than the suggested range based on the system type



# MEKO-FREE ANTI-SKINNING AGENTS FOR ALKYD COATINGS

MEKO (Methyl-ethyl-ketoxime = 2-Butanone oxime) anti-skinning agents are commonly used to prevent in-can skinning in alkyd coatings. However, MEKO alternatives are in demand as MEKO has been facing regulatory issues around the world. In Canada, MEKO concentrations are restricted in indoor alkyd paints available to consumers and have been added to their Environmental Emergency Regulations. In the European Union, the European Commission has classified MEKO as a Carcinogen Cat. 1B, effective March 1, 2022, with labeling required at  $\geq 0.1\%$  MEKO content (European Commission: ATP 15 part 3 Annex VI).

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## MEKO-free anti-skinning agents from Borchers include:

### Ascini<sup>®</sup> Anti-Skin 0444

Solventborne high solids formulations, printing inks, clear coats, and pigmented coatings

### Ascini<sup>®</sup> Anti-Skin 0445

Waterborne and solventborne clear coats and pigmented coatings

### Ascini<sup>®</sup> Anti-Skin 1240

Solventborne clear coats and pigmented coatings

### Borchi<sup>®</sup> Nox 1640

Solventborne colorless and pigmented coatings

### Borchi<sup>®</sup> Shield

Solventborne high solids formulations

Cobalt driers are commonly used with MEKO anti-skinning agents in alkyd coatings to decrease dry times. However, like MEKO, cobalt may also face regulations due to their carcinogenic, sensitization, and reproductive toxicity concerns in coating applications. Regions such as the European Union, South Korea, and the United States are considering cobalt regulations for the future.

**Borchi<sup>®</sup> OXY-Coat high-performance catalysts** are cobalt replacement driers that are designed

to decrease dry times, yellowing, and drier complexity in alkyd systems. They further increase sustainability and performance in coatings when used with MEKO-free anti-skinning agents.

**Formulating with both MEKO-free anti-skinning agents and high-performance catalysts avoids the need to reformulate cobalt-containing coatings in the future.**



Europe, Canada, and other nations have proposed reduction levels of MEKO (Methyl-ethyl-ketoxime = 2-Butanone oxime) in alkyd paints



Sustainability is increased in alkyd paints when MEKO-free anti-skinning agents are used with high-performance cobalt replacement catalysts like Borchi<sup>®</sup> OXY-Coat



Both MEKO and cobalt face regulatory pressures

# HIGH-PERFORMANCE CATALYSTS

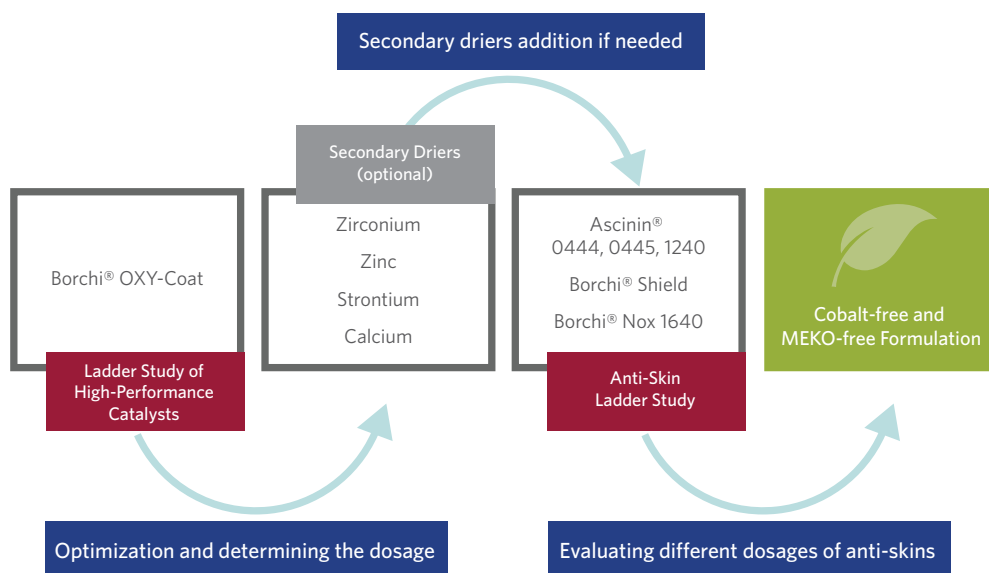
The diagram below shows how formulators can combine novel MEKO-free and high-performance catalyst technologies to enable sustainable and efficient performance in coatings.

Alkyd coatings that contain Borchers' MEKO-free and high-performance catalyst solutions may not require the use of secondary driers. Some formulations with high-performance catalysts may also not require an anti-skinning agent.

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Product(s)	MEKO-Free Anti-Skin(s) to Use	Application	Description
<b>Borchi® OXY-Coat</b> <b>Borchi® OXY-Coat 1310</b> <b>Borchi® OXY-Coat 1410</b>	<b>Ascinin®</b> Anti-Skin 0444 / 0445 / 1240  <b>Borchi®</b> Nox 1640  <b>Borchi®</b> Shield	Solventborne short, medium, and long oil architectural, wood, and industrial alkyd coatings	Improves drying activity, color performance, gloss, and haze compared to cobalt-based driers. Can be used in coatings for adverse weather conditions.
<b>Borchi® OXY-Coat 1101</b>	<b>Ascinin®</b> Anti-Skin 0445	Waterborne short, medium, and long oil architectural, wood, and industrial alkyd coatings	VOC-free catalyst. Improves drying activity, color performance, gloss, and haze compared to cobalt-based driers. Can be used in coatings for adverse weather conditions.



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formulating safer  
alkyd-based coatings?**

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and performance data  
on MEKO-free and  
cobalt-free coatings.

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