

Borchers' Anti-skinning Agents and Anti-oxidants

Ascinin[®], Borch[®] Nox, and Borch[®] Shield

Modern Antioxidants for air-drying coating systems

Over the course of its lifecycle, every material undergoes a continuous change in its properties due to molecular processes caused by:

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|----------|-------------------------|
| ▪ Light | ▪ Moisture |
| ▪ Heat | ▪ Trace metals |
| ▪ Oxygen | ▪ High-energy radiation |
| ▪ Ozone | |

This process is called aging. Stabilizers (Antioxidants) can be used to delay the aging process. Some of the technical fields of application for Antioxidants and the processes they prevent are:

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|------------------------------|--------------------------------|
| ▪ 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.

THE FUNCTION OF ANTIOXIDANTS

Anti-oxidants 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:

(1) Use of radical interceptors

Radical interceptors react with the atmospheric oxygen diffusing into the binder and form stable, non-reactive radicals. Phenolic antioxidants (preferably sterically hindered solutions) are generally used for this application.

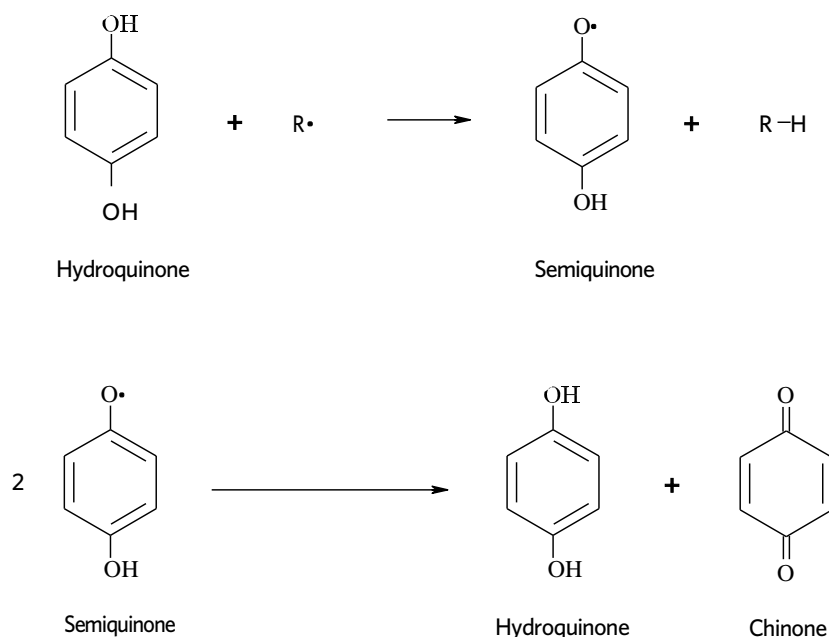
(2) Use of complexing agents

Complexing of the siccative metal with organic complexing agents causes a temporary deactivation of the oxo-catalytic center. The most important group of these metal ion deactivators is aliphatic ketoximes.

Borchers offers compounds with both mechanisms of action for different applications under the brand names ASCININ[®], BORCHI[®] NOX, and BORCHI[®] SHIELD.

Radical interceptors

Radical interceptors react with the free radicals formed during auto-oxidation (e.g., $R\cdot$, $R-O\cdot$, $R-OO\cdot$) and deactivate them. A simple example is hydroquinone:



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

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. It has been found that ketoximes and aldioximes are particularly suitable as deactivators because they have favorable technical properties. The products most commonly used today are butanone oxime (methyl ethyl ketoxime, MEKO) and cyclohexanone oxime. 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 Ascinin® are registered trademarks of Borchers GmbH, Langenfeld, Germany. These are product names of anti-oxidants and anti-skinning agents that we produce and market for all types of oxidatively drying coating systems.

Product	Chemistry	Application	Description	Dosage
Ascinin® Anti Skin 0444	Amino compound dissolved in 1,2-propanediol	Solvent borne 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 solvent borne systems	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
Ascinin® Anti Skin 0445	Amino compound dissolved in fatty acid ester	Waterborne and solvent borne 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 solvent borne systems	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
Ascinin® Anti Skin 1240	Amino compound dissolved in fatty acid ester	Solvent borne clear coats and pigmented coatings	MEKO-free and Reduced VOC content. Specially designed for oxidatively drying coatings systems and pastes. Higher volatility than Ascinin® Anti Skin 0444 and 0445	Paints: 0.2-0.6% Printing inks: 0.5-2.0% Pigment pastes: 1.0-3.0%
Borchi® Nox 614	Phenolic anti-oxidant in solvent blend	Solvent borne colorless and pigmented coatings	Acts as an anti-skinning agent and flow promoter in colorless and pigmented coatings. Enhances the gloss and flow properties of air-drying systems	1.0 - 3.0%
Borchi® Nox C3	Cyclohexanone oxime	Solvent borne 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%
Borchi® Nox 1640	Cyclohexanone oxime	Solvent borne paint formulations	MEKO-free. Does not cause discoloration or adversely affect the drying time of the paint system. Higher volatility than Ascinin® Anti Skin 0444 and 0445	0.2 - 1.5%*
Borchi® Nox M2	Methyl ethyl ketoxime	Solvent borne	Delays the onset of drying of clear lacquers without affecting through drying. Prolongs the open time of the film, thereby preventing flow problems and blistering	0.2 - 1.0%
Borchi® Shield	Amino / oxime compound dissolved in fatty acid ester	Solvent borne high solids formulations	MEKO-free. Works synergistically with Borchi® Dragon ligand technology in high solids, long oil alkyds to provide slower surface drying, allowing for proper oxidative through cure even with thicker films	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 is currently classified as a carcinogen, and regions such as [Europe](#) and [Canada](#) have proposed regulations that would require lower amounts of MEKO to be used in finished paints, which in turn would make it difficult for applicators to prevent in-can skin formation. **The European Commission recently published (ATP 15 part 3 Annex VI) the entry of MEKO with the classification of 1B carcinogen with a concentration limit at $\geq 0.1\%$. This classification will take effect on March 1st, 2022. From this date onward, formulators cannot utilize MEKO if it meets or exceeds the concentration limits.**

Borchers' MEKO-free options help formulators effectively prevent skinning while preparing for upcoming regulatory requirements.

MEKO-free anti-skins from Borchers include:

- [Ascini[®] Anti Skin 0444](#)
- [Ascini[®] Anti Skin 0445](#)
- [Ascini[®] Anti Skin 1240](#)
- [Borchi[®] Nox 1640](#)
- [Borchi[®] Shield](#)

Cobalt driers are commonly used with MEKO anti-skins in alkyd coating formulations to decrease dry times. However, like MEKO, [cobalt may also face regulations](#) within the coatings industry. Regions such as the European Union are considering cobalt regulations for the future. High-performance cobalt-free catalysts are cobalt replacement driers that are designed to sustainably decrease dry times, yellowing, and drier complexity in alkyd systems. They further increase sustainability and performance in coatings when used with MEKO-free anti-skins.



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-skins are used with high-performance cobalt replacement catalysts like **Borchi[®] Dragon** or **Borchi[®] OXY-Coat**

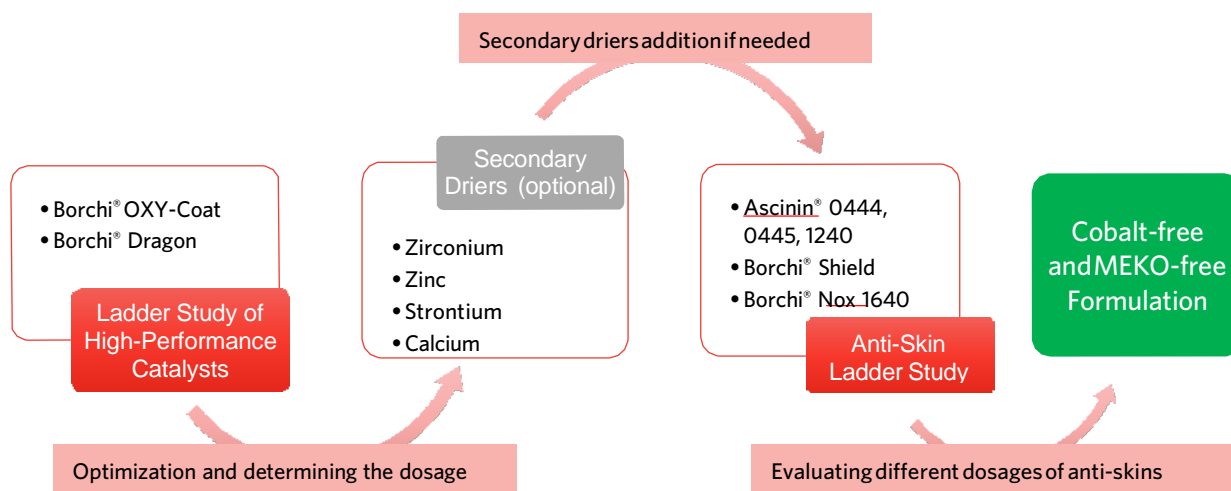


Both MEKO and cobalt face regulatory pressures

High-Performance Catalysts from Borchers include:

Product(s)	MEKO-Free Anti-Skin(s) to Use	Application	Description
Borchi® OXY-Coat / Borchi® OXY-Coat 1310 / Borchi® OXY-Coat 1410	Ascinin® Anti Skin 0444 / 0445 / 1240 , Borchi® Nox 1640 , Borchi® Shield	Solvent borne 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
Borchi® OXY-Coat 1101	Ascinin® Anti Skin 0445	Waterborne short, medium, and long oil architectural, wood, and industrial alkyd coatings	VOC-free. Improves drying activity, color performance, gloss and haze compared to cobalt-based driers. Can be used in coatings for adverse weather conditions
Borchi® Dragon	Ascinin® Anti Skin 0444 / 0445 / 1240 , Borchi® Nox 1640 , Borchi® Shield	Solvent borne high solids, long oil architectural, wood, and industrial alkyd coatings	Improves drying activity, color performance, gloss and haze compared to cobalt-based driers. Prevents wrinkling and provides excellent film hardness in high solids systems

The diagram below shows how formulators can combine novel MEKO-free and high-performance catalyst technologies for 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. Please contact tech.service@borchers.com for more information.

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