China United Chemical Int.
China United Chemical International Company Ltd.

A Revolutionary Green Renewable Bio-wax

– Chemically Modified Rice Bran Wax

Company Profile

In 2010, while modified processing of crude montan wax was underway at our Shanghai factory, we started producing oxidized rice bran wax to partially substitute Montan Wax S in response to some customers' demand for cost reduction.

To address the risk of tight supply of crude montan wax, we established a brand-new factory in Chongqing in advance to produce three major categories of chemically modified rice bran wax, including oxidized rice bran wax, esterified rice bran wax, and saponified rice bran wax, with over ten different models. The new factory was completed and put into operation in 2018. Currently, the series of chemically modified rice bran wax has been widely accepted by the market.

Overview of Rice Bran Wax

Rice bran wax is a by-product of rice processing, obtained through cooling, crystallization and separation during the refining process of rice bran oil. It is a brown pasty by-product, commonly known as crude rice bran wax. Crude rice bran wax requires further refining to possess application value.

China is the world's largest rice producer, accounting for about one-third of the world's total output. If fully utilized, China can produce more than 20,000 tons of rice bran wax each year.

China began producing rice bran wax in the 1960s and 1970s. Initially, rice bran wax was all brownish, sticky solid; it was obtained by degreasing wax paste through saponification. In the early 1970s, a method using solvent extraction to remove residual oil from wax paste was developed to produce hard but brownish rice bran wax.

In the late 1980s, the first factory in Songjiang Dongjing, Shanghai, produced light-colored refined rice bran wax using a combination of composite solvent extraction and hydrogen peroxide oxidation, significantly upgrading the quality of the wax.

Brownish rice bran wax is only used in carbon paper, ink and shoe polish. Refined rice bran wax is mainly exported to Japan, the United States, Germany and Italy, and is used as a natural plant wax in food, medicine and cosmetics.

It was found that the main component of rice bran wax is fatty acid esters formed by the combination of long-chain fatty acids and long-chain fatty alcohols.

Further analysis revealed that the carbon chain length of fatty alcohols in the ester ranges from C22 to C38, predominantly even-numbered carbons (accounting for 95%), with C30 being the main component. The carbon number distribution of fatty acids in the ester ranges from C20 to C34, with C24 having the highest content.

By comparing the chemical structure, composition and other properties of rice bran wax, it is found that it is very similar to Carnauba wax and Montan wax (Germany). From a biochemical perspective, their biosynthetic mechanisms and biological functions are the same.

Despite the similarity, their market applications are completely opposite. Montan wax has been widely used in various industries, especially in engineering plastics, electronic packaging, water-based inks and other fields, while rice bran wax has almost no application in these industries.

Refining Rice Bran Wax Using the Refined Montan Wax Process

Drawing on the experience of processing Montan wax, inspiration was gained for the refining process of rice bran wax. Using strong oxidants instead of hydrogen peroxide to decolorize Montan wax can not only effectively solve the decolorization problem but also achieve chemical structural changes. Rice bran wax with a composition close to that of Montan wax can also be oxidized with the strong oxidant sodium dichromate, and even a new type of substance can be obtained.

As early as 1996, Li Yinfu, a senior engineer and the pioneer of lignite wax production in China, successfully produced rice bran wax decolorized by sodium dichromate in Dalian. However, at that time, it was only intended to replace the solvent-decolorized refined rice brown wax.

In 2010, on the basis of absorbing Li Yinfu’s experience, Shanghai Hecai Chemical not only used oxidized rice bran wax to replace refined rice bran wax but also carried out work to replace Montan wax.

In 2011, to expand production scale, Shanghai Hecai Chemical invested in Tongnan, Chongqing, registered and established **China United Chemical International Company LTD.**

After the completion of the Chongqing factory in 2018, it began full-scale production of the chemically modified rice bran wax series.

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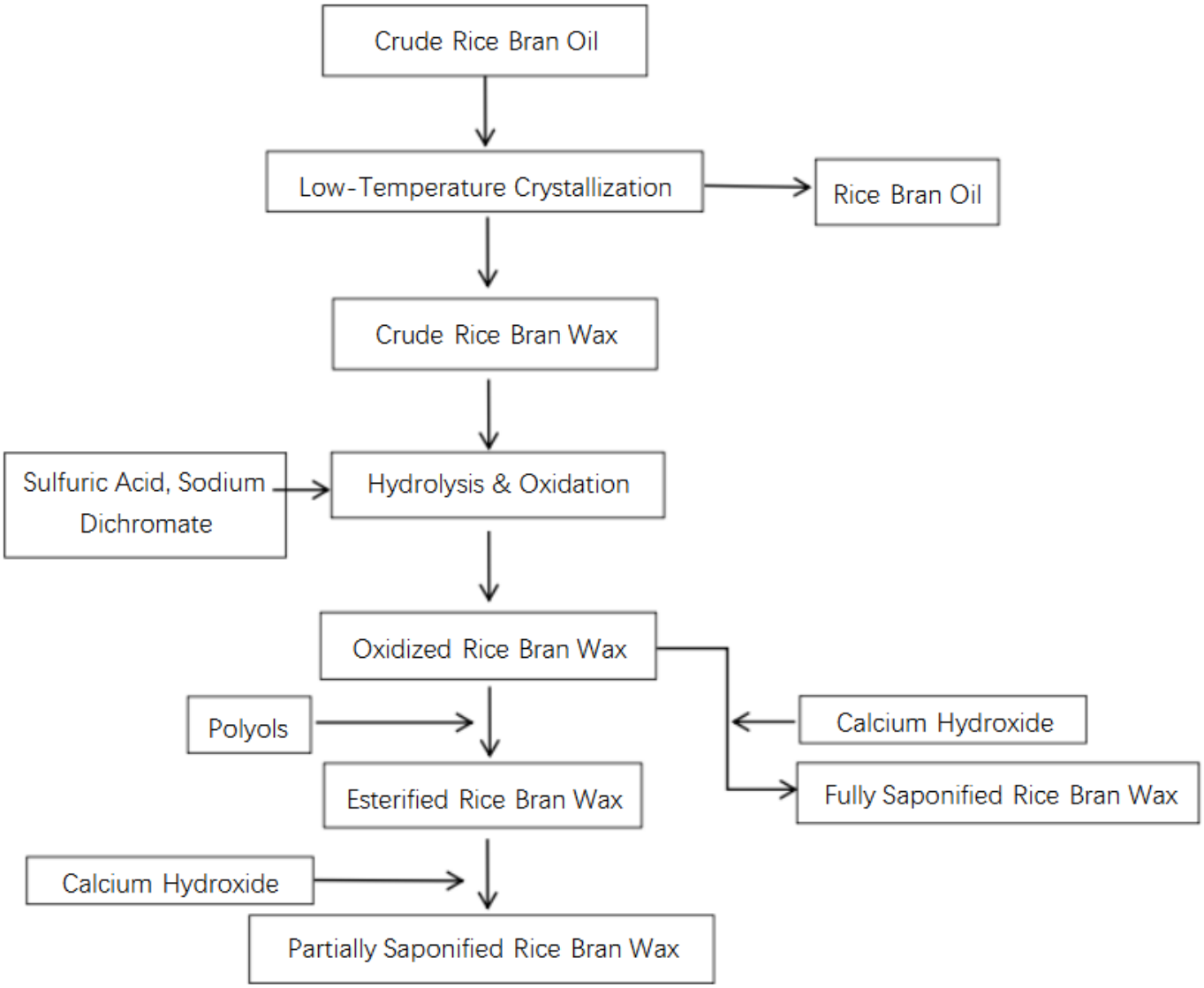
The Purpose of Chemical Modification of Rice Bran Wax

1. Remove oils, pigments, phosphoric acid substances and furfural resin from rice bran wax. Oils affect product hardness and gloss, and furfural resin is the main cause of odor.
2. Hydrolyze long-chain fatty acid esters into long-chain fatty acids and long-chain fatty alcohols, then oxidize long-chain fatty alcohols into long-chain fatty acids.
3. The long-chain fatty acids obtained through hydrolysis are further esterified with polyols to produce esterified rice bran wax, and saponified with calcium hydroxide to produce saponified rice bran wax.



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Chemical Reactions of Rice Bran Wax

1 Bleaching with chromic acid solution→Removal of Residual Oil and Impurities

$$R\text{-}COO\text{-}CH_2\text{-}R' + \text{dark matter} \xrightarrow{+[O_2]} R\text{-}COO\text{-}CH_2\text{-}R' + xCO_2\uparrow + yH_2O$$

2 Oxidation with chromic acid solution→Oxidized waxes

$$R\text{-}COO\text{-}CH_2\text{-}R' + H2O \xrightarrow{+H^+} R\text{-}COOH + HO\text{-}CH_2\text{-}R'$$

$$R'\text{-}CH_2\text{-}OH + O_2 \xrightarrow[-H_2O]{} R'\text{-}COOH$$

$$R\text{-}COO\text{-}CH_2\text{-}R' + O_2 \xrightarrow{[H^+]} R'\text{-}COOH + R'\text{-}COOH$$

3 Esterification with mono and polyvalent alcohols→ Esterified Rice Wax

$$R\text{-}COOH + HO\text{-}R \rightarrow R\text{-}COOR$$

$$R\text{-}COOH + HO\text{-}(CH_2)_2\text{-}OH + HOOC\text{-}R \xrightarrow[-2H_2O]{} R\text{-}COO\text{-}CH_2\text{-}CH_2\text{-}OOC\text{-}R$$

$$HO\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}(CH_2)_2\text{-}OH + \underset{\displaystyle R\text{-}COOH+}{HOOC\text{-}R} \xrightarrow[-2H_2O]{} R\text{-}COO\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}(CH_2)_2\text{-}OOC\text{-}R$$

4 Saponification with metal hydroxides→Saponified Rice Wax

$$2R\text{-}COOH + Ca(OH)_2 \xrightarrow[-2H_2O]{} (R\text{-}COO)_2\text{-}Ca$$

5 Combination of 3 and 4→Partially saponified ester waxes

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Product Catalog

Characteristic	Product	Melting point (°C)	Acid value (mgKOH/g)	Saponification value (mgKOH/g)	Appearance
Oxidized rice bran wax	Bio-R® 02	78 - 80	70 - 95	160 - 200	Light yellow to white flake
	Bio R® 03	78 - 80	40 - 60	150 - 190	Light yellow flake
	Bio R® 07	78 - 80	120 - 140	160 - 200	Light yellow to white flake
Esterified rice bran wax	Bio R® 04	78 - 80	10 - 20	100 - 130	White powder
	Bio-R® RSL	78 - 80	28- 33	100 - 130	White powder/white flake
	Bio-R® 14	78 - 80	20 - 30	120 - 160	White powder/white flake
	Bio R® RLE	78 - 80	20 - 30	120 - 160	White powder
Saponified rice bran wax	Bio-R® 05	97 - 102	5 - 20	100- 130	Light yellow flake /powder
	Bio-R® 53	140 - 150 (Dropping point)	< 5	120 - 160	Light yellow powder
	Bio-R® 301	-	< 3	-	Light yellow powder
	Bio-R® 502	-	5 - 10	-	Light yellow powder
Micropowder rice bran wax	Bio-R® 802	78 - 80	70 - 95	160 - 200	D50:7-10μ m
	Bio-R® 804	78 - 80	10 - 20	100 - 130	D50:<7μ m
	Bio-R® 805	97 - 102	5 - 20	100 - 130	D50:<7μ m
	Bio-R® 815	91 - 97	5 - 20	100 - 130	D50:<7μ m

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Recommended Application Field

Product Name	Chemical Structure	Market Recommendation Level	Application Fields					
			TPU	PA	Ink & Coating	PA、PET Nucleating agent	Epoxy EMC	Masterbatch
BIO-R®04	Esterified Wax (E-Wax)	★★★★★	●●●				●●●	●●●
BIO-R®05	Saponified Wax (OP-Wax)	★★★★★		●●●			●●●	●●●
BIO-R®502	Saponified Wax (Nucleating Agent)	★★★★★		●●●		●●●		
BIO-R®802	Oxidized Wax Micropowder	★★★★★			●●●			
BIO-R®07	Oxidized Wax (S-Wax)	★★★★★					●●●	
BIO-R®53	Saponified Wax (OP-Wax)	★★★		●●●				
BIO-R®301	Sodium Soap (Nucleating Agent)	★★★				●●●		
BIO-R®02	Oxidized Wax (S-Wax)	★★★						
BIO-R®03	Oxidized Wax (Carnauba Wax Alternative)	★★★						
BIO-R®804	Ester Wax Micropowder	★★★			●●●			
BIO-R®805	Saponified Wax Micropowder	★★★			●●●			
BIO-R®815	Saponified Wax Micropowder	★			●●●			
BIO-R®RSL	Esterified Wax	★						
BIO-R®RLE	Ester Wax with Emulsifier	★						

Qualifications & Certifications

China United Chemical International Co., Ltd. was the first company to apply for CAS numbers covering esterified rice bran waxes and chemically modified rice bran waxes produced through esterification and

subsequent saponification processes. The company has successfully completed the REACH registration for oxidized rice bran waxes and has also taken a leading role in obtaining REACH registrations for esterified and saponified rice bran waxes. In addition, China United is currently pursuing European food-contact certification for selected esterified rice bran wax grades.