

POLYVINYL ALCOHOL (PVA)

Chemical and Technical Assessment (CTA)

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1 Summary

Polyvinyl alcohol (CAS no. 9002-89-5) was placed on the agenda of the 61st JECFA. Polyvinyl alcohol was first prepared by Hermann and Haehnel in 1924 by hydrolyzing polyvinyl acetate in ethanol with potassium hydroxide. Polyvinyl alcohol is produced commercially from polyvinyl acetate, usually by a continuous process. The acetate groups are hydrolyzed by ester interchange with methanol in the presence of anhydrous sodium methylate or aqueous sodium hydroxide. The physical characteristics and its specific functional uses depend on the degree of polymerization and the degree of hydrolysis. Polyvinyl alcohol is classified into two classes namely: partially hydrolyzed and fully hydrolyzed. Partially hydrolyzed PVA is used in the foods.

Polyvinyl alcohol is an odorless and tasteless, translucent, white or cream colored granular powder. It is used as a moisture barrier film for food supplement tablets and for foods that contain inclusions or dry food with inclusions that need to be protected from moisture uptake.

Polyvinyl alcohol is not known to occur as a natural product.

2 Description

Polyvinyl alcohol for food use is an odourless and tasteless, translucent, white or cream colored granular powder. It is soluble in water, slightly soluble in ethanol, but insoluble in other organic solvents. Typically a 5% solution of polyvinyl alcohol exhibits a pH in the range of 5.0 to 6.5. Polyvinyl alcohol has a melting point of 180 to 190°C. It has a molecular weight of between 26,300 and 30,000, and a degree of hydrolysis of 86.5 to 89%.

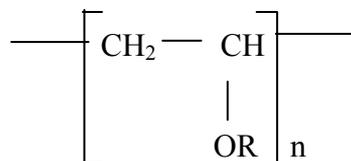
3 Manufacturing

The primary raw material used in the manufacture of polyvinyl alcohol is vinyl acetate monomer. It is manufactured by the polymerization of vinyl acetate followed by partial hydrolysis. The process of hydrolysis is based on the partial replacement of ester group in vinyl acetate with the hydroxyl group, and is completed in the presence of aqueous sodium hydroxide. Following gradual addition of the aqueous saponification agent. Polyvinyl alcohol is precipitated, washed and dried. The degree of hydrolysis is determined by the time point at which the saponification reaction is stopped.

4 Chemical characterization

4.1 Composition

The structure of polyvinyl alcohol (partially hydrolyzed) is given below:



where R = H or COCH₃

4.2 Possible impurities (including degradation products)

Impurities resulting from the manufacturing process include sodium acetate, methanol and methyl acetate. Levels of sodium acetate, a reaction by-product, are monitored using the residue on ignition test. The residual methanol and methyl acetate are monitored during the manufacturing process.

No detailed information on the presence of unreacted monomer in the polymer is available.

4.3 Analytical methods

No quantitative method is available for the determination of PVA although, various methods have been described for the detection of PVA. Filter paper treated with potassium iodide and iodine solutions has been suggested for measuring Polyvinyl alcohol concentration in wastewater in a concentration range of 1000-20,000 mg/l. the color of polymers, including Polyvinyl alcohol, and their derivatives in various solvents have been used to identify them. The green complex formed by reaction of polyvinyl alcohol with boric acid has been used to detect small amounts in polyvinyl chloride resins.

4.4 Rationale for specifications

JECFA has evaluated polyvinyl alcohol (partially hydrolyzed) as a moisture barrier coating for foods.

5 Functional uses

5.1 Technological function

Polyvinyl alcohol has various applications in the food industries as a binding and coating agent. It is a film coating agent specially in applications where moisture barrier/ protection properties are required.

As a component of tablet coating formulations intended for products including food supplement tablets, Polyvinyl alcohol protects the active ingredients from moisture, oxygen and other environmental components, while simultaneously masking their taste and odor. It allows for easy handling of finished product and facilitates ingestion and swallowing. The viscosity of Polyvinyl alcohol allows for the application of the Polyvinyl alcohol coating agents to tablets, capsules and other forms to which film coatings are typically applied at relatively high solids contents.

5.2 Food categories and use levels

Polyvinyl alcohol may be used in high moisture foods in order to retain the overall satisfactory taste, texture and quality of the foods. Confectionery products may also contain Polyvinyl alcohol in order to preserve the integrity of the moisture sensitive constituents.

Use levels for polyvinyl alcohol were developed by the sponsor assuming the application of 2.3 mg PVA/cm² in aqueous film coatings. Maximum use levels of polyvinyl alcohol were derived for the final foods by selecting products within each food category with the greatest proportion of moisture sensitive components, estimating the surface area of those components, and assuming coating of the entire surface area with polyvinyl alcohol.

Use levels of Polyvinyl alcohol		
Food Category	Proposed Food-Use	Use Levels for Polyvinyl alcohol (%)
Dairy-based desserts	Ice cream and frozen yogurt with inclusions	0.2
Confectionery	Multi-component chocolate Bars	1.5
Cereals and cereal products	Ready to eat breakfast cereals with dried fruits	0.5
Food supplements	Food supplement tablets	1.8
Ready to eat savorys	Nut and fruit mixtures	1.5

6 Reactions and Fate in Food

The food products in which Polyvinyl alcohol is intended to be used have neutral pH and are stored at either low temperature or at room temperature conditions that would not result in breakdown of PVA. Similarly the food products in which Polyvinyl alcohol is used have pH in neutral range and will not likely to have any impact on its stability. Water solutions of Polyvinyl alcohol are also stable.

The structure of Polyvinyl alcohol would not be conducive to hydrolysis reaction of the remaining ester groups or to esterification reactions undergone by secondary alcohols with relatively strong nucleophiles.

Under intended conditions of use and storage there would be negligible interaction between Polyvinyl alcohol and food constituents.

7 References

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