

food and food related products. Used in convenience-type food to improve shelf life and freeze-thaw stability. Used in paper industry as a furnish additive. Used in textile industry in sizing, finishing and printing also they find use as a binder. Hydroxyalkyl starches with high molar substitution are useful as blood plasma volume extender and imparting freeze-thaw stability to blood cells.



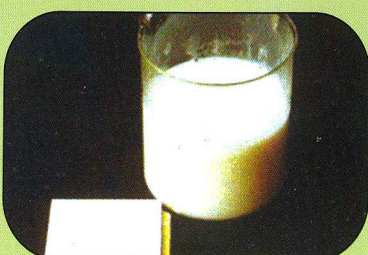
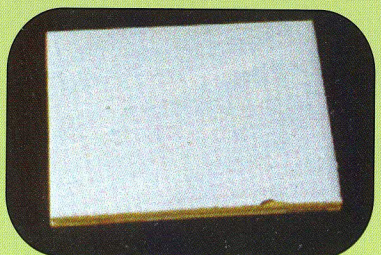
### Special Adhesives

Adhesives for specific applications are prepared by mixing pre-gelatinised starch with synthetic polymer in a suitable solvent.

Starch is gelatinized in minimum water and the polymer is added in fixed quantity with continuous stirring and a suitable solvent added to give a uniform paste.

Product is pure white in color, free flowing having viscous consistency and water resistance.

It has binding property to stick all the materials especially glass and ceramics.



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## MODIFIED TUBER STARCHES IN INDUSTRY



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It is a modified starch which has been rendered cold water soluble by pre-gelatinization followed by drying. The product is granular and miscible in cold water, has high viscosity and tack.

Pre-gelatinized starch is prepared by gelatinizing starch with minimum quantity of water, cooling, drying at 60-80°C and pulverization. It can also be prepared by using drum drier, which is very fast and gives product with very good colour and appearance. Pre-gelatinized starch finds applications as instant starch in textile and paper sizing and in food as thickeners.



### Starch esters

These are modified starches, where the OH groups have been replaced by ester groups by chemical reactions. Various esters include formates, acetates, butyrates, succinates, phosphates etc.

Starch esters are prepared by treating starch with acids, acid anhydrides and acyl chlorides in alkaline medium. Properties depend on the type of derivative, degree of substitution and reaction conditions. They possess varied viscosity characteristics, gelatinization and swelling properties and other functional properties. Some special features like film forming capacity and freeze-thaw stability are also exhibited by esters.

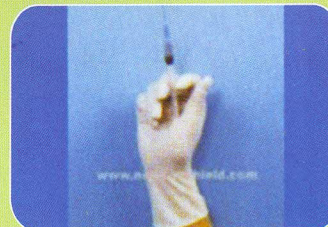
Starch esters are mainly used in food products as thickeners and stabilizers. They are also used in canned foods and frozen desserts. Other applications include textile, paper and adhesive industries



These are modified starches, where the starch molecules are reinforced through cross-links. Various reagents used for cross-linking include phosphorous oxychloride, epichlorohydrin, phosphate salts and adipic-acetic mixed anhydride. Cross-linked starches are prepared by treatment of starch with reagents in alkaline medium at temperatures below the gelatinization temperature of starch.

Properties depend on the reagents used and the extent of cross-linking. Viscosity can be enhanced/lowered by manipulating the reaction conditions. Higher gelatinization temperatures and good viscosity stability can be achieved for specific applications.

Cross-linked starches are used as surgical dusting powders, carriers, absorbents and ion-exchange resins. Used in textile sizing and in bakery products.



### oxidized starch

Partial oxidization of hydroxyl groups in starch by mild oxidizing agents leads to formation of aldehyde and acid groups. The common reagents used for oxidation are sodium hypochlorite solution, hydrogen peroxide solution, chlorine water etc. Starch is treated with oxidizing agents at room temperature in slightly alkaline media, the resulting granular product is filtered, washed thoroughly and dried.

Oxidized starches are white, has good film forming capacity and low viscosity enabling higher concentrations to be used. Oxidized starches are used mainly in paper industry as sizing and finishing agents, especially for special papers. It also finds use in food and textile industries.



Starch with cationic functional groups such as amines and amides are called cationic starches. They are produced by the chemical reaction of starch with reagents containing positive charge like amino, imino, ammonium or phosphonium groups.

Reagents commonly used are 2-diethyl aminoethyl chloride, 2,3-epoxypropyl trimethyl ammonium chloride, diallyl cyanamides and ethylene imine. Reactions are carried out in alkaline medium at room temperature. Dispersions of cationic starch show improved clarity stability and stable viscosity. Possess high dispersibility and cold water solubility even at low degree of substitution.

Used in paper industry as a wet-end additive, sizing and coating in textile industry, as a flocculent in detergents and cosmetics, as fluid loss control agents in oil wells, adhesives and in graft copolymers.



### Hydroxyalkylated starches

These are derivatives where the OH groups in starch are linked with alkoxy groups. Ether derivatives of starch are prepared by the reaction of starch with ethylene/propylene oxide. Starch is treated with ethylene or propylene oxide in alkaline conditions at low temperature in aqueous/alcohol medium.

The important properties are lower pasting temperature, viscosity stability, clarity, freeze-thaw stability and lower tendency to retrograde. Films are clearer and more flexible than native starch. These are stable to acids, bases and salts.