



Usage of vegetable tanning products beyond tanning

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The use of vegetable tanning agents within leather making is well known for both tanning and the distinctive colours that these products provide. But these historic and present day uses of these natural products are not just restricted to the leather sector. In the history of pharmacology the role of barks, fruits, leaves and roots of several trees containing vegetable tannins are well accepted for curing different diseases, wound healing and general health problems. But there are also many other examples of usage in different fields and industries, and new uses are being investigated.

Natural dyestuffs

The dyeing properties of vegetable tannins resemble historical “dyewoods” such as hematine and fustic. These extracts also dye natural fibres such as cotton and silk directly.

To increase their light and wash fastness properties additional auxiliaries are used during processing. Eco-friendly textile production using tannins are predicted to become popular in future, even though they produce restricted colour ranges^{2,3}. Hydrolysable tannins give beige, brown and yellowish colours, whereas condensed tannins give pinkish and reddish shades.

Pigment production

The paint and ink industries consume huge amounts of organic and inorganic pigments.

The salts of iron, copper and other metals can react with vegetable tannins under controlled conditions of pH, temperature, and concentration to form insoluble precipitates as “colour lakes” of different colours. Once filtered, dried and ground these precipitates provide black, brown, yellow and blue coloured pigments, although low tinctorial values and heat fastness are the major disadvantages.

Wood adhesives

Synthetic resins made from urea-formaldehyde (UF) and phenol-formaldehyde (PF) are classical adhesives in plywood, fibreboard and particle board production, as well as in foundry use.

However, tannins of quebracho, mimosa, mangrove, pine bark, valex (valonia extract) have all been used as replacements for these resins. In particular, hexamine or paraformaldehyde react with tannins and form useable adhesives. Fast gelling, shorter pot lives and higher costs restrict their usage, but nevertheless the free tannin content acts as a scavenger and reduces formaldehyde emissions when used together with UF or PF resins.

Cooling towers and steam boiler systems

Expensive and often hazardous chemicals are used to prevent scaling, fouling and deposits within the cooling towers of industrial plants. Research has shown that modified mimosa and valex are suitable replacements in many situations.

Corrosion and scaling are headaches in steam boilers as they reduce both the efficiency and life of the plant. However, tannins act as a scavenger to remove oxygen dissolved in the boiler feed waters, but, in addition, any iron oxide formed chelates with tannins to form a film and prevent corrosion.

Prevention of proteolysis

Alfalfa, wheat corn, sugar beet and the pulp of silage materials are widely used as feedstuff for ruminants (sheep, goat, cattle) due to their high nutritional values. However, there are losses due to extensive proteolysis of proteins that occurs during ensiling and wilting. For the prevention of proteolysis chestnut, valex and quebracho are recommended as silage additives.

Impregnation of wood products

Toxic chemicals are used for the preservation of indoor and outdoor wood / timber products against termites and insects. As an environmentally friendly alternative tannins have been advocated, and in particular both mimosa and quebracho show satisfactory anti-termite and insecticidal properties. Impregnation into thick timber requires vacuum treatment, and natural resins obtained from pine or juniper are recommended as a carriers for the impregnant. Metal complexes formed between copper and these tannins, give improved results in wood preservation against rotting and fungal activity.

The construction industry

Several modified vegetable tannins show behaviour as water reducers and set-retarders in concrete mixtures, where they are suggested as replacements for lignosulfonates, naphthalene sulfonates and polycarboxylates. Modified tannins of quebracho, chestnut and valex are advocated to increase the open time, binding and slip resistance (anti-sagging) capacities of concrete based tile/grout mortars instead of more expensive cellulose ethers and starch ethers.

Wastewater treatment

Treatment of wastewaters with synthetic polyelectrolytes for flocculation can be replaced in some situations with chestnut or valex in conjunction with aluminium sulphate. The components



of household and industry wastewaters need selective flocculation, and in some circumstances the natural polyphenolic structure of tannins helps both in precipitation and the formation of aggregates for easier solids removal.

The prevention of metal corrosion

Heat exchangers, reactors and industrial tanks made from alloys face corrosion problems if they are in contact with basic or acidic or salt containing solutions, but condensed tannins (mimosa and quebracho) are proven as corrosion inhibitors in low concentrations for long term resistance.

Toxic inhibitors such as lead and chromate salts have been used for the prevention of rust formation on iron surfaces, but tannic acid derived from Chinese gall nuts when added into specialised paints acts as a “rust converter” and provides successful protection.

Other applications

Sumac, tara and gall nut are used in different countries for precipitation of residual proteins in wine and beer making for clarification and the improvement of taste. For the enrichment of metal oxides, sulfides and silicates of copper, magnesium, nickel and zinc mineral ores, the usage of modified condensed tannins has been suggested as flotation depressors, as a replacement for other inorganic salts.

Conclusions

The uses for many vegetable tanning extracts will increase both as chemical replacements within established technologies and for obtaining improved yields or value in new fields. In this respect, the secondary or tertiary important tannins, such as, mangrove, sumac, red pine bark, avaram bark, etc., are under focus for applications and uses in fields other than the tanning sector.

It is believed that within the next 10 years the usage of vegetable tannins in tanneries will decrease, whereas other fields will consume up to 50% of total world production of these products. ☺

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