Ecology

Freedom from dependence on formalin

Non-waste technology of adhesive resins at woodworking enterprises

Module formaldehyde/UFC 85 plants with high degree of prefabrication located directly at woodwork plants are capable of satisfying needs of the plant in raw materials for production of adhesives in situ.

The wood working industry mostly based on comparatively cheap adhesives containing formaldehyde. They are much cheaper than alternatives (emulsion, PVA, epoxy resins) being acceptable by bonding parameters.

Two main sources of adhesives used by wood board plants are known to the world of today:

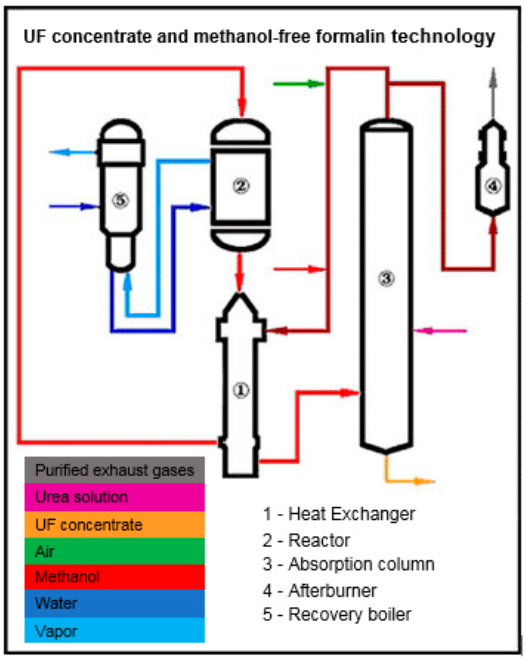
- centralized supply from major manufacturers of chemicals
- cooking the resin in situ at the wood working plant.

Both ways are widespread in Russia and CIS countries. The traditional resin manufacturing process is used since 1960th and long ago ceased to match growing environmental protection requirements. Besides, lack of due attention from large manufacturers to the quality of produced raw materials compels wood working users to withstand pressure from environmental authorities and struggle to keep their resin facilities running.

Typical UF resin facility that produces resins for wood board and plywood manufacturing uses 37% formaldehyde solution in water stabilized by methanol and urea. This resin is cooked in reactors equipped with agitators and heating cooling devices (coils or jackets). The polycondensation process goes at strictly preset conditions of acidity and temperature. Excessive water containing methanol and formalin is removed by vacuum distillation (drying) followed by final condensation of non-reacted formaldehyde with urea.

Vices of such process are long known. Among those are effluents in considerable quantities, losses of formaldehyde and methanol, long process of cooking and drying, extensive steam and electricity consumption,

low producing capacity. Moreover, in winter all formalin storage facilities need steam to keep the temperature above the polymerization point. Formalin is partly evaporated, partly turns to paraformaldehyde that forms sediments in storage tanks. 300 kg of contaminated water is generated in process of cooking standard UF resin (KFMT-15 brand) per one ton of resin.



Comparative study of traditional and Safe Technologies proprietary processes

Production parameters	Traditional process	Safe Technologies process
1	2	3
A. Formaldehyde production		
1. Source material type	Methanol-water mix	Methanol
2.Type / life period of the catalyst	Silver / 6 months	Metal-oxide (ferromolybdenum) / 3 years+
3. Reaction temperature	650 °C	340 °C
4. Formaldehyde production per 1 t of	1,84	2,35
5. Maximum formaldehyde concentration in the product	37,0 ±0,5 % (by GOST 1625)	up to 57%
6. Methanol content in the product	4...8% (by GOST 1625)	< 0,3 %
7. Gas emission decontamination	Natural gas flare	Catalytic conversion
B. Resin production		
1. Type of the process	Liquid phase, batch	Semi continuous
2. Main raw materials	1. Formalin 37 % (Flammable, Hazard class by GOST12.1.005-76:2) 2. Urea	1 .Methanol, flammable, Hazard class by GOST12.1.005-76:3) 2. Urea
3. Necessity of heating of liquid raw materials storage in winter	Yes	No
4.Storage tank material for flammable source storage	Stainless steel	Typical carbon steel
5. Synthesis time	6 ... 8 hours	4...5 hours
6. Reactor volume - efficiency ratio	0,80	0,95
7. Production per day from one volume unit of the reactor	1,6...2,2 t	4,2... 5,2 t
8. effluents per 1 ton of product	0,25...0,30 t	Absent
9. Consumption per 1 ton of resin - electric power - steam	12... 15 kW/h 500kg	3... 5 kW/h 100kg

Typical wood board plant with the capacity of 100 cubic meters of board consumes about 12000 MTPY of resin. Therefore, more than 3000 MTPY of contaminated water containing about 40 ton of formaldehyde and more than 300 ton of methanol find its way into water treatment facility. Such burden on the environment is deemed unacceptable.

This problem drew considerable attention recently from scientific and industrial researchers. Various solutions were being proposed, such as drying, burning, and bonding of free formaldehyde by ammonia or urea, returning the water to the raw material manufacturer, etc.

Unfortunately, all those solutions were not widely implemented being rather inefficient and impractical.

St. Petersburg company Safe Technologies, which is known for its scientific potential as well as for its production capabilities developed zero-waste semi continuous process of UF resin production with gas-liquid process of formaldehyde synthesis by oxidizing methanol on metal-oxide catalyst in module structured prefabricated plants. The plant is assembled as single module with proprietary layout and structure.

This process is a combination of continuous formaldehyde synthesis and its periodic polycondensation with urea in heated reactors conducted according to advanced, zero-waste and energy sparing technology.

The UF concentrate production process goes as follows: methanol is evaporated and mixed with air, being heated up by exiting reaction gas. Entering main catalytic reactor it is oxidized by ferromolybdenum catalyst to formaldehyde. The flow then is directed to absorption tower where it is absorbed by urea solution forming urea-formaldehyde concentrate. Air with traces of methanol, formaldehyde and some side product is discharged to the atmosphere via catalytic converter, where it is fully decontaminated. The process is fully automatic and controlled by one operator. Only urea -formaldehyde concentrate and urea are fed to the agitated heated and

cooled reactor where the resin
is being produced in

controlled acidity/alkalinity conditions. Produced resin is directed to the storage.

According to Central Research institute of Plywood, which is a head organization in the field of resin technology development, such module plant is an embodiment of energy saving environmentally safe and efficient process of formaldehyde resin production.

The advantages of such technology compared with the traditional one are numerous:

- total absence of effluents or solid waste in the process
- negligible emission
- two times the production capacity of the equipment
- lower steam and electric power consumption
- shipment and storage costs reduction

This innovative process enables wood working plant to enter new level of production, reaching new grade of wood board safety E1 and E0.5.

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UF concentrate and methanol-free formalin technology