Application

ABB Analytical – pH Measurement
Tall Oil Production

Industry: Pulp and paper

Refining tall oil

Tall oil has its origins in the Kraft pulping process. During this process, cooking chemicals at high temperatures and elevated pH digest the wood, creating pulp. A byproduct of the pulping process is black liquor. This liquor contains the cooking chemicals, residual pulp, and resin or pitch from the trees. Tall oil is the refined form of the pitch and resin.

Tall oil refining is most common in pulp mills that rely on conifer wood for production since this wood tends to be high in resin content. When distilled, tall oil can be broken down into source chemicals for adhesives, mining floatation chemicals, printing inks, soaps, turpentine, and lubricants. Some mills will have tall oil distillation facilities on-site. Others sell the crude tall oil to chemical producers who provide the additional distillation steps for a specific end product.

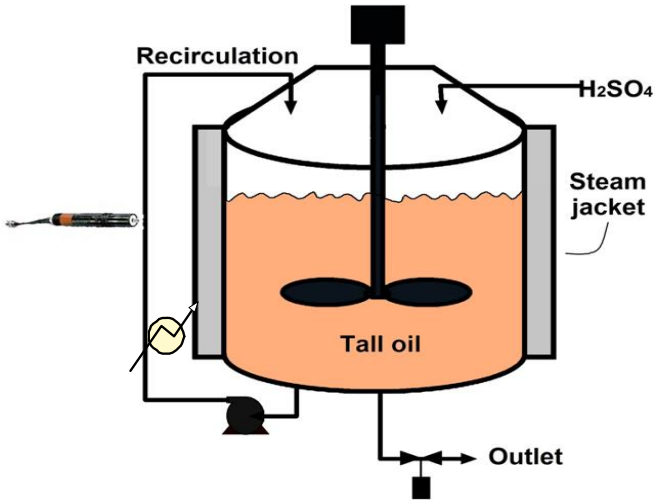
Separation and acidification

The lower density tall oil undergoes initial separation from the black liquor in a black liquor storage tank. The plant skims the tall oil soap from the surface of the black liquor and pumps it to another storage tank. Additional settling takes place in this second tank. Any residual pulp and black liquor entrained with the tall oil soap continues to settle out. Throughout the process, temperatures can range from 140°F to 212°F (60°C to 100°C). The elevated temperatures help to reduce viscosity, facilitating pumping from tank to tank.

The plant next pumps the separated tall oil to a reactor and adds sulfuric acid. The sulfuric acid helps to break the tall oil into separate fatty and resin acids. These two new liquid components continue on for further refining. Sulfuric acid will also combine with calcium compounds to precipitate calcium sulfate, removing another impurity from the tall oil.

Controlling pH

To encourage separation of the tall oil into fatty and resin acids, the acidification reactor is normally held to about 4 pH. A large mechanical agitator mixes the sulfuric acid and tall oil to ensure that the pH stays uniform throughout the vessel. The reactor's steam jacket keeps the mixture at high temperatures. The pH will be held at this level for roughly one day while the acid reacts with the tall oil. Up until the mid-1990's, online measurement of pH at the acidification reactor was considered impossible by many pulp mills.



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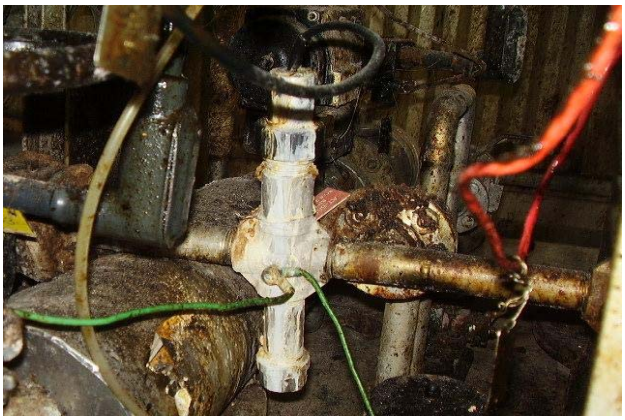

A pH sensor mounted into a 1-inch tee fitting in the tall oil plant. Nearly everything has a sticky coating due to the nature of the application.

The combination of high temperatures, low pH, and coating by the tall oil would render most pH sensors useless within several days. Hydrogen Sulfide (H_2S) created by the reaction of sulfuric acid with the tall oil also impaired the sensing of pH by quickly penetrating the reference electrode and poisoning the sensor.

Initial trials at pulp mills in the United States found that ABB's TB(X)5 sensors could withstand the harsh environment in tall oil production. ABB's patented Wood Next Step Reference resists coating and plugging by the tall oil. Internal seals within the reference effectively slow the poisoning effects of hydrogen sulfide.

The TB(X)551 can be mounted into 1" tees in sample line installations

The ABB Solution: TB(X)5 Sensors

Installation of the pH sensor in the tall oil acidification reactor can be difficult. Since the reactor has a steam jacket and an agitator, a direct measurement of pH within the reactor is not practical.

ABB recommends mounting the pH sensor on a recirculation line off the reactor. This allows isolation of the sensor for cleaning and calibration. The recirculation line may need heat tracing to help reduce the viscosity of the tall oil. The additional heat also helps prevent coating on the glass electrode. The Wood Next Step Reference and J glass electrode should be specified for these applications. The ABB TB(X)551 sensor is often a popular choice. The twist lock mounting style allows for easy sensor removal from the recirculation pipeline. As for transmitters, the TB82PH or new APA592 Endura unit with Exd housing both suit these applications.

New APA592 Endura Transmitter with Exd housing.

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