ALCOHOL FROM PHILIPPINE MANGROVE SWAMPS

By

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An adequate supply of oil is vital to the development of the country. Oil is a prime commodity and the government has been spending a huge amount of dollars yearly for its importation. This is a fact and our disadvantage at that, long well-known to all—our leaders, policy-makers, intellectuals, professionals, students and workers alike. For its remedy, something should have been done a long time ago. Had we done something about this problem earlier, we probably would not be too-badly affected by the superpower play behind fossil fuel used as a political weapon. We probably would be energy sufficient now, had we taken the lead on the search for the science and technology of renewable and readily available mineral energy substitute source—the motor fuel alcohol from agricultural crops highly regarded now as the strength for the future for the oil-poor countries. However, as the saying goes "it's never too late", the challenge is well taken. It offers a marvelous opportunity to discover our own indigenous skills and resources.

Industrial alcohol or simply alcohol is basically ethanol or ethyl alcohol. In industry, ethanol is a highly priced commodity. Its solvent value is second only to water. Nearly all industries employed alcohol either as interme diates in the synthesis of many chemicals or by themselves. Alcohols are generally employed as solvents, antifoaming agents and evaporation retardants in reservoirs. Their use as chemical intermediates, however, accounts for the largest amount of alcohols produced. By relatively simple chemical reactions, alcohols can be converted into a great number and variety of chemical compounds. Also ethanol, is an essentially necessary ingredient for alcohol beverages.

Generally, alcohol comes in combination with other admixtures of substances which are difficult to separate. This alcohol smells and tastes bad and is nonpotable. This is the completely denatured alcohol. For special purposes, alcohol may be specially denatured. It is employed for its medicinal, pharmaceutical and flavoring value. Specially denatured alcohol is alcohol in its almost pure form.

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Raw materials from which ethanol may be made fall into four general classifications: 1) fermentation of natural products like sugars, starchy materials, fruits and inflorescence, 2) chemical synthesis based on hydrocarbons from petroleum or natural gas, 3) chemical treatment of natural fats and oils, and 4) destructive distillation of cellulosic materials such as wood, agricultural residues and waste sulfite liquors.

Most of the alcohol produced by the industrial fermentation industries is obtained from hexose sugars by yeast. The most common substrate for the production of industrial alcohol are molasses, grain, sulfite waste liquor and wood waste. The fermentation is carried out for the most part in the absence of air. The alcohol is finally purified and concentrated by distillation. In the face of the modern day energy crisis and the fast depletion of the hydrocarbon sources, fermentation processes based on renewable raw materials are likely to become the most important methods for the production of alcohols.

The first petrochemical manufactured on industrial scale was isopropyl alcohol in 1920. Alcohol from synthetic manufacturing procedures has been and until recently the most important source. The major synthetic processes employed to commercially obtain alcohols are the reduction of synthesis gas, the hydration and oxonation of hydrocarbons, the condensation of aldehydes followed by reduction and the reduction of animal fats and vegetable oils.

Although there is an absence of a formal investigation as to the costs and returns of processing nipa toddy or harvesting the nipa leaves for low cost roofing and walling of light homes, it is obvious (from personal interviews) that the activity is income generating. With relatively little effort and minimal inputs, in a short while, nipa shingles are ready for the market or alcohol is bottled for the consumers. For nipa toddy, the benefit-cost ratio of processing is quite high apparently because: 1) equipment is simple and improvised which means relatively small capitalization; 2) nipa palm is a perennial plant, normally flowers every year, therefore, once a nipa plant starts to bear flowers, it will bear flowers every year; 3) maintenance cost of the area earmarked for alcohol production means cleaning the plant of dried leaves, thinning out of over-crowding fronds, planting in open spaces and other activities prior to the start of the tapping season which call for relatively small expenses.

In a recent trip to Infanta, Quezon, some interesting and self-revealing findings were collected. Mang Aurelio owns a 1.5 hectares of nipa swampland. The area is around 90 percent covered by "sasa", the local name of nipa palm. Ordinarily, distillation starts in July and ends in April. However, for this year, it was shortened to three months because

of the three strong typhoons which visited the place. Many of the nipa leaves were destroyed, the plant just refused to bear flowers when the leaves are destroyed and jarred by strong winds. The distillery visited was idle, but even then the husband and wife team patiently answered the many questions asked.

During the distillation season, Mang Aurelio goes out to collect "tuba", the local name for nipa toddy, as early as 5 o'clock in the morning. In the afternoon, at around 4 o'clock another collection is made. Collection of tuba around the 1.5 hectares would last up to 2 to 3 hours. Before the tuba is cooked, it is set aside in a tapayan (earthen jar) for 3 days to allow the sugars in the tuba to be converted into alcohol. Due to the lack of containers, tuba collected in subsequent days are added to previous collections.

Cooking of tuba is done by the wife in a half-size drum (extractor) which is filled to about 1/2 full. Around 5-1/2 pails of tuba is cooked in every batch, out of which one "dama-juana" glass jar called "stoper" or some 5 gallons of distillate is obtained. It has been observed that distillate collected earlier in the distillation is strong. This strength diminishes towards the end of the cooking. The first batch which started very early in the morning took around 3 hours. Other batches which follow thereafter is shorter than the former. Four stopers are obtained in a day because there are 4 batches of distillation. The number of cooking greatly depends upon the volume of tuba collected and made ready for the distillation process. If tuba is distilled right immediately after collection in the morning, only about 1/2 stoper or 2-1/2 gallons of distillate is obtained out of 5-1/2 pails of tuba charged.

The reflux is called "tuong". It is made of wood and when idle it is soaked in running water to prevent the attack of termites. It is frustum-like in shape whose vertical height is almost equal to that of the drum extractor and whose bottom is wide open and exactly fits the mouth of the drum. The other end of the tuong is covered while at its center is a hole about 2-inch in diameter. Some of the vapor pass through this opening to the tumbok. At the opposite sides of the tuong are two openings, one-inch in diameter. One of these openings is for the passage of alcohol condensate and the other is for the outlet of the exhaust water.

The "tumbok" is the condenser. Vapors unable to condense in the tuong are finally condensed in the tumbok. It is a stainless steel and has the size and shape of that of the crash-helmet of the motorcyclist. Sometimes, a "caldero" is also used. This is placed over the 2-inch diameter hole of the tuong. Cold water continuously flows over the tumbok to keep it cool all the while.

Vapor leakage in the tuong or anywhere in the set-up is checked by placing over it layers of decayed banana stalks. This covering also helps decrease the temperature of the tuong which allows better condensation of the vapor.

The distillate goes out of one of the side openings of the tuong. It passes through an open trough which is made of bamboo, one meter in length to the stoper fitted with a plastic funnel. Distillate is collected hot. There is no practice to control quality of the product. The strength of the condensate is approximated by its actual taste.

Water from the irrigation serves as the cooling water. Cold water from the water tank flows continuously over the hot tumbok to cool it. Exhaust water becomes hot and goes out of the side opening of the tuong and then back to the freely flowing water. Water is manually taken from the nearby running water and transferred to the tank which is elevated 2 meters from the ground.

Firing of the tuba contained in the drum is by closed furnace type. The space right below the bottom of the drum is empty to about 1 foot high. This is enclosed by hardened clay or mud to the rim of the drum. An opening of around 1 foot square is provided for the entrance of the fuel. The clay or mud enclosure is then used as an insulator to keep the heat inside the drum of toddy and as well as a furnace for the cooking. Life span of the drum used for cooking is from 4 to 5 months. Solid fuel, dried nipa leaves or any combustible material is used for firing.

In a day, one liter of nipa toddy is easily collected from the tapped inflorescence. Tapping period per plant is around 50 days. If 15% of the nipa plant is tapped in a hectare—the nipa inflorescence available for tapping in a time and 50 tapping days per plant, some 105,000 liters of toddy is collected per tapping season of 4 months. If there is 5% conversion of the toddy to alcohol and ₱2 per liter of the cost of alcohol, a total of ₱10,500.00 is obtained from one hectare of nipa swamp tapped in a year. For 1.5 hectares, there is an annual income of about ₱15,750.00.

The alcohol making industry in the swampland faces a stiff competition from fishpond operators who also have an eye on the same piece of land. With enormous capitalization, a swampland earmarked for fishpond development is first cleared off any plantlife by burning. Deep excavation follows to remove the unwanted roots and rhizomes of nipa plants. Dikes are then constructed and floors of the ponds leveled. The area is now an open tract of land of around thirty hectares per fishpond owner made ready for the bangus and shrimp culture.

However, whenever the nipa swamp is left to itself for the tapping process for the alcohol-making of the rural folks, it is an untampered estuary generally underestimated because it is often thought to be of little economic value. The fact is that it makes a substantial contribution to the food chain that supports the fishes which is our major source of protein food. This food chain is also essential to the productivity of nearby estuaries and some ocean fisheries. Mangrove swamps have also been found to be an important breeding ground of shrimps, lobsters, crabs and other seafood which have great export potentials. The area forms an environment which is ideal for most fishery organisms for acclimatization and as a nursery and rearing ground for fish eggs, larvae and young spawners.

In the very near future, with the worldwide sources of fossil fuels depleted or hoarded as a political weapon, it is foreseen that the fermentation process for renewable raw materials supplied by our agricultural crops is one of the best alternative answers in our modern day energy crisis.