BIOGAS

Using rice straw as raw material

MD. MAMUNUR RASHID

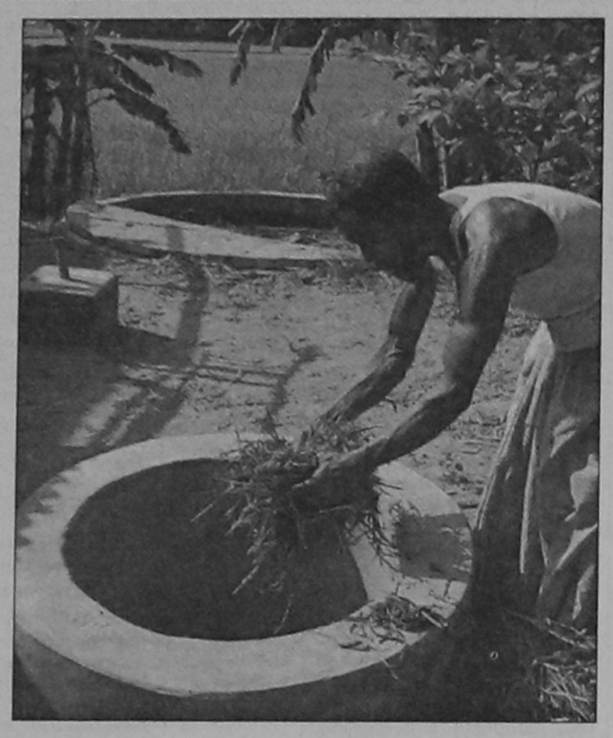
In India, Punjab has taken a project to use rice straw for the generation of electricity. Punjab roughly produces 100 million tonnes rice straw which would yield 108 MW of electricity. The first plant will be operational within this year. So why should not we, when we are facing huge energy crisis?

ADEQUATE and uninterrupted supply of energy is the basic demand for economic growth and development of any country. Earth's energy crisis and global warming from energy sector, day by day, enhance the demand for renewable energy. Although several options of renewable energy have been discovered, Biogas and Solar are the most prominent renewable energy sector still now. Biogas technology is most popular throughout the world because it not only produces energy but also ensures better and hygienic environment, good health and other socioeconomic benefit as the technology convert the biodegradable organic waste from agriculture, industries, municipalities, livestock etc. to energy and supplies the slurry as a by product that can be used as organic fertilizer.

Biogas is a mixture of 50 to 70% of Methane (CH4), 30 to 40% of Carbon di oxide (CO2), Hydrogen Sulphide (H2S) and moisture generated after the fermentation of biodegradable organic wastes in the absence of oxygen which is known as anaerobic digestion process. Biogas is about 20 percent lighter than air and has an ignition temperature in the range of 650 degrees to 750 degrees C. It is an odourless and colourless gas that burns with clear blue flame similar to that of LPG (Sathianathan, 1975). Its calorific value is 20 Mega Joules (MJ) per m3 and burns with 60% efficiency in a conventional biogas stove.

Biogas can be used to transform its energy content into different forms like mechanical energy and heat energy. Cooking, lighting, refrigeration and production of electricity by running internal combustion engine are the common uses of biogas. A variety of organic wastes are used as raw materials for biogas production i.e. manure of pig, cow, horse, sheep and poultry; grass, elephant grass, vegetable residuals, water hyacinth, municipal solid waste, sewage sludge, rice straw etc. In Bangladesh most of the biogas plants are based on the cow dung for its availability. Cow manure have a biogas yield of 150 350 lit/kg of VS and rice straw have 170 280 lit/kg of VS.

Rice straw was not used as raw material for biogas production last time because bacteria cannot easily break down its cellulose due to complex physical and chemical structure of lignocellulosic biomass as well as gas production yield was low compared to other available raw materials although rice straw is the most available material in the country. In the recent time researchers have found out the technology to use rice straw as a raw material for biogas production, with increased gas production yield.



Rice straws are lignocellulosic materials with a low bulk density and relatively high silica content. The main chemical components on a dry basis are cellulose, hemicelluloses, lignin and ash. Lignin is found in the middle lamella and adjacent primary cell walls of the residue tissue, and as such it encapsulates the cellulose and hemicellulose fractions found primarily in the secondary cell walls. Rice straws have relatively high proportions of silica-rich ash. Very recently researchers in China have developed a solid-state sodium hydroxide (NaOH) pretreatment process that can boost the production of biogas from rice straw by almost 65% by increasing its biodegradability (Xiujin Li. et. al.).

They also observed degradation of 16.4% cellulose, 36.8% hemicellulose, and 28.4% lignin, while water-soluble substances were increased by 122.5%. The ester bond of lignin-carbohydrate complexes (LCCs) was destroyed through the hydrolysis reaction, releasing more cellulose for biogas production. The linkages of inter units and the functional groups of lignin, cellulose, and hemicellulose were either broken down or destroyed, leading to significant changes of chemical structures. The original lignin with a large molecular weight and three-dimensional network structure became one with a small molecular weight and linear structure after NaOH pretreatment. The cellulosic crystal style was not obviously changed, but the crystallinity of cellulose increased.

The changes of chemical compositions, chemical structures and physical characteristics made rice straw more biodegradable and thus responsible for enhancement of the biogas yield.

In another study it was found that pre-treatment of rice straws reduce the retention time in anaerobic digestion process (F. Wenjie. & Xiujin Li.). Ruihong Zhang and Zhiqin Zhang investigated the effects of different pretreatment methods, physical (mechanical), thermal and chemical (ammonia) treatment, on the digestion of rice straw at the mesophilic temperature of 35°C. A combination of grinding (10-mm length), heating (110°C), and ammonia treatment (2%) resulted in the highest biogas yield, 0.471g-1VS-1 fed, which is 17.5% higher than the biogas yield of untreated whole straw. Pre-treatment temperature has a significant effect on the digestibility of straw.

For proper anaerobic digestion, the raw material should have a carbon to nitrogen ratio of approximately 30:1. Rice straw has a carbon to nitrogen ratio of 80 -100:1. Therefore to attain the correct ratio a source of nitrogen such as animal manure, night soil, ammonia etc must be added. Using the formula we can easily find out that how much manure or other nitrogen rich substrate we need to add to attain the preferable C/N ratio. The fibrous nature of rice residues may pose a problem, as residues tend to float and form a hard scum on the surface of digester. In this case, special measures must be taken -- maceration of the slurry before feeding into the digester and intermittent or continuous mechanical mixing during digestion (Barreveld, 1989; Marchaim, 1992).

Mixing of nitrogen rich manure i.e. cow dung with rice straw will increase the specific gravity of the mixed substrate, which will also reduce the floatation tendency of the rice straw in the reactor. In addition we can introduce UASB (Up-flow Anaerobic Sludge Blanket) type reactor in place of conventional fixed dome and floating type reactor. It will increase the loading rate, eventually reducing the volume in reactor. The three phase separation system in UASB reactor will also help to reduce the floatation of rice straw as well as formation of hard scum.

Bangladesh is an agricultural country and rice is the main agricultural product which is cultivated almost throughout the year resulting huge amount of rice straw left in the agricultural field. The common practice with this waste straw is to burn in the field which cause air pollution and other is to plough in the field as according to agricultural experts straws are rich source of organic manure. But rice straw requires a lot of time to decompose while undecomposed straw cause problem during sowing.

On the other hand if we use rice straw as a raw material by setting up rice straw based biogas plant we can reduce the air pollution as well as decomposed slurry can be used as organic fertilizer in the paddy field. Biogas produced from the plant can be used for running an internal combustion engine to produce electricity which can be used for running electrical pumps as well as biogas can be directly used in modified diesel engine to run shallow pump or low lift pump for irrigation in rural areas where electricity supply is not adequate.

Surplus electricity and biogas can be distributed to the adjacent farmer families for lighting and cooking purposes. If it can be done total socio economic scenario will be changed dramatically.

In India, Punjab has taken a project to use rice straw for the generation of electricity. Punjab roughly produces 100 million tonnes rice straw which would yield 108 MW of electricity. The first plant will be operational within this year. So why should not we, when we are facing huge energy crisis? This is the high time to think about the alternative way to produce energy.

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5TH WORLD WATER FORUM

Addressing the planet's water crisis

THE 5th World Water Forum, the world's largest water-related event, will convene in Istanbul, Turkey March 16-22, 2009, to push the worldwide water crisis onto the international agenda. Held every three years, the Forum gathers together interested parties from every horizon to find sustainable solutions to the world's daily water challenges. With more than 3000 participating organizations, attendees will include international heads of state, United Nations representatives, parliamentarians, local authorities and other government officials, as well as water professionals, activists and other interested parties. The Forum is a unique platform where individuals from both inside and outside the water sector interact and debate to create broader awareness for water-related issues and find solutions. During this year's forum, the United Nations' World Water Development Report will be unveiled giving insight to freshwater resources.

According to the United Nations Environment Programme, two-thirds of the planet will live in water-stressed conditions by 2025 if present consumption patterns continue. "The ultimate goal of the 5th World Water Forum Istanbul 2009 is to motivate action to improve the world's management of water resources," says Prof. Dr. Oktay Tabasaran, the Forum's secretary-general. "This can only be done by raising awareness of the importance of water-related issues. However, global awareness must be followed by action -- such as legislation, funding, governance and empowerment -- all of which are promoted through the Forum."

Turkey, the host country of this year's Forum, offers a unique position due to its location as a crossroads between continents, regions, cultures, and civilizations. It provides an ideal atmosphere for the Forum's theme, "Bridging Divides for Water." Bringing together contrasting viewpoints such as supply and demand, rich and poor, developed and developing worlds, the Forum is put together as a result of the collaboration between Turkish Ministry of Foreign Affairs, the General Directorate of State Hydraulic Works and the Istanbul Metropolitan Municipality, as well as the World Water Council.

The Forum has four distinct objectives: emphasizing water's importance to gain a spot on the political agenda; fostering discussions to solve international water issues; formulating concrete proposals and bringing their importance to the world's attention; and generating political commitments.

"Water conservation and management are massive global concerns," says Loïc Fauchon, World Water Council president. "The Forum promises to garner unprecedented international interest, support and exposure surrounding global water issues." Sustainability is a fast-growing problem directly affected by most global environmental issues such as pollution, population growth, land-use changes and climate change. Without worldwide efforts aimed at sustainability, more extreme and devastating events are expected to occur. For instance, climate change could make droughts more frequent in many areas already coping with water scarcity.

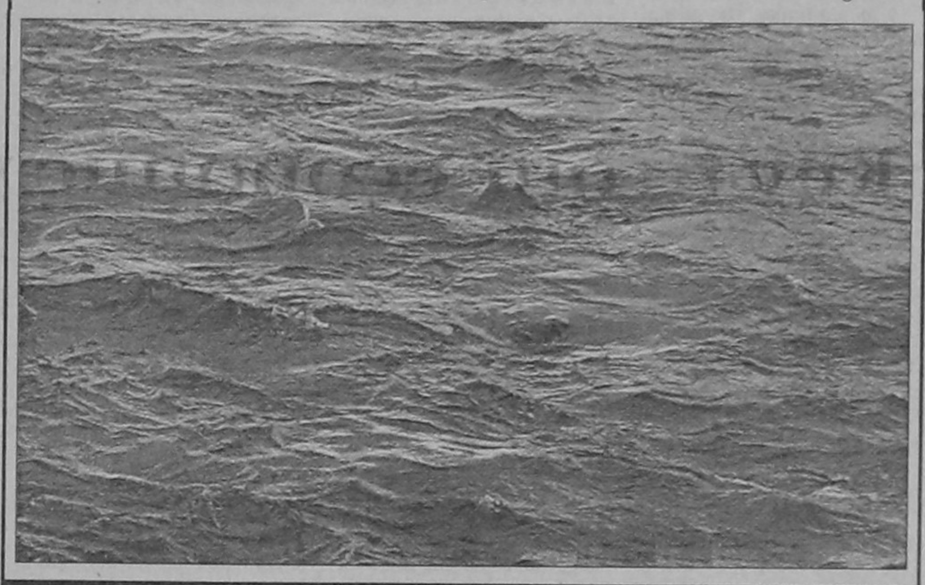
According to the World Water Council, major river basins, including important food-producing areas around the Colorado River in the United States, the Indus River in southern Asia, the Yellow River in China, the Jordan River in the Middle East, the Nile Delta in Africa, and the Murray Darling River in Australia, are at capacity with no possibility of using more water from these sources.

Nearly 10,000 participants are expected to attend the Forum, which will feature approximately 100 sessions. The sessions are grouped into six main themes:

- Global Change & Risk Management
- Human Development and Millennium Development Goal Advancement
- Water Resources and Supply Systems Management and Protection to Meet Human and Environmental Needs
- Governance and Management
- Finance
- Education, Knowledge and Capacity Building

For more information on the 5th World Water Forum, please visit www.worldwaterForum5.org.

The World Water Forum is the international meeting place where the world comes together to share concrete solutions for water issues. It is organized every three years by the World Water Council and the host country's government, and is the result of more than two years of preparation involving people from all regions, sectors and backgrounds. Previous Forums have been held in Morocco (1997), the Netherlands (2000), Japan (2003) and Mexico (2006). For more information on the World Water Forums and the World Water Council, please visit www.worldwatercouncil.org.



INDOOR ENVIRONMENT

Crucial for healthy living

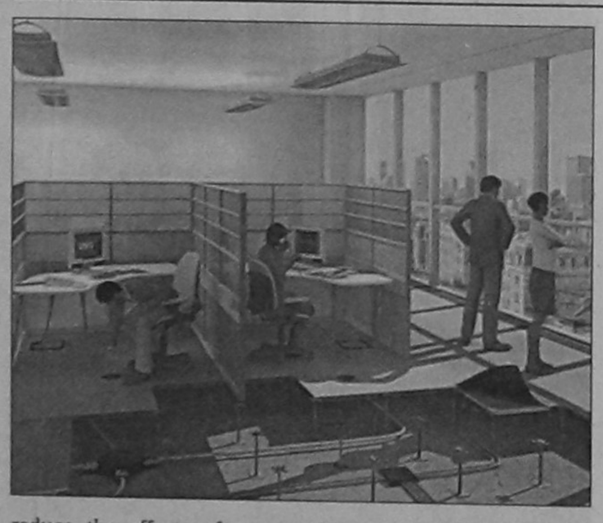
MAHFUJUR RAHMAN

The parameters of our surrounding environment have profound effect on our physical and mental health as well as on our productivity at offices, factories and home. As we stay most of the time at home, office or other work places indoor environmental conditions is very crucial for our healthy living.

INDOOR environment is a somewhat narrower concept in the paradigm of environmental sciences. It is manifested by many factors. The ambient environmental condition depends basically on several fundamental factors such as air quality, sound pollution and temperature. Factors of ambient environmental conditions include: Temperature, Humidity, Dust and Particulate matter, Toxic gases, Harmful radiation, Microbial spores, Sunlight and other light , Sound pollution, Atmospheric pressure.

Temperature: Perhaps the most important factor in determining comfort to an organism is its surrounding temperature. Result of extreme temperature is known to us all. Think of the biting cold and sweltering heat of summer. If the indoor temperature is colder than the body temperature, the human body conducts heat energy to the surrounding air and gradually loses heat (you feel cold). If temperature is too warm, excess heat builds in the body and the body has trouble releasing that heat to the surrounding air (you feel hot). Very low temperature also can reduce the physiological activities to an alarming state. Similarly, very high temperature can make us ill due to water loss from the body.

Humidity: Humidity is the second important factor of ambient environment. Physical comfort and discomfort depends on the humidity of the place to a great extent. When it comes to feeling comfortable in your home, the old saying "it's not the heat (or cold) - it's the humidity" rings true. Nothing affects a body's perception of comfort more than the humidity level. And there's a fairly narrow range between what is considered "too much" and "too little" of it. Industry experts state that keeping your home's humidity between 30-60% can help



reduce the effects of many unwanted conditions. Excess humidity or too little humidity not only leads to an unhealthy home but also causes permanent damage to your home and belongings.

Dust and particulate matter: Dust particles are harmful to health as well as a great cause of discomfort in a place. Particulate matter is anything that is suspended in the air. It can be caused by natural phenomena or come from man-made sources. In high enough concentrations, particulates can aggravate existing respiratory problems or even trigger new ones. Smoke, dust, soot -- all of these are airborne particulates that are inhaled every time we breathe. These particulates are classified by their size. Larger or "coarse" particles range in size from 2.5 to 10 micrometers in size, while "fine" particles are smaller than 2.5 micrometers. All of these are far too small to be seen with the naked eye.

Toxic gases: In modern life thousands of chemicals we use everyday and generate millions of chemical compounds as a result. Many of them are toxic gases that cannot only harm our lungs but may jeopardize our over all health. According to the EPA, concentrations of toxic pollutants can be up to one hundred times greater inside a home than outside, in our smoggiest cities. Poor ventilation in the home can lead to stuffy air and a build-up of unpleasant odors, irritating pollutants and potentially harmful gasses such as radon or carbon monoxide. As homes are built tighter with better windows, more insulation and higher-efficiency heating and cooling systems, the need for adequate ventilation becomes even more important to be safe from toxic gases.

Harmful radiation: Use of energy is multiplied thousand times compared to primitive pastoral lifestyle before industrial revolution. The use of energy varies a lot from lighting our homes to running the motor vehicles. However, some use of energy creates radiation that is quite harmful to our health. Along with that use of radioactive materials for varying purposes such as Chemotherapy is a very common phenomenon now-a-days.

Microbial spores: Ambient air of a place may contain spores of certain microbes or plant pollen. These microscopic biological substances may pose risk of health hazard when they are inhaled with air.

Sunlight and other light: Direct sunlight makes a person feel warmer because electromagnetic radiation is being embedded directly into the skin. If the temperature feels uncomfortably cool in the shade, standing in direct sunlight will make one feel warmer. But exposure to excessive sunlight or other light may have certain adverse effect on health. Even absence of light is also harmful to health. In presence of light our skin produces vitamin D which is necessary for good health, especially useful for sound formation of bone and teeth. Excessive exposure to sunlight may even yield skin cancer for the ultraviolet content of sunlight is causative agent for it.

Sound pollution: Suppose, you are a sick person and you are compelled to live in the busiest part of a city where a lot of vehicles ply and many factories are also run. If someone asks you which phenomenon at your residence is the most irritating to you? Most possibly the answer will be irritating sound from horn of motor vehicles and factories. In city life sound pollution has in fact a very long run effect on physical and mental health of the exposed people.

Atmospheric pressure: Change in atmospheric pressure can be a cause of illness. Both very high and low air pressure can disturb our healthy living. Very low air pressure at top of mountain can rapture mucosal membrane of our nose and even cause it to bleed. High pressure of atmosphere can cause dissolution of nitrogen in our blood if we dive and go deep under water. Ease of respiration in room is also affected by air pressure. If air pressure is too low then it becomes a laborious job to continue respiration.

Conclusion: Ambient environment is manifestation of our surrounding environment that we actually face in our everyday life. The parameters of our surrounding environment have profound effect on our physical and mental health as well as on our productivity at offices, factories and home. As we stay most of the time at home, office or other work places indoor environmental conditions is very crucial for our healthy living. Certain parameters of the indoor environment such as temperature, humidity, particulate matter and presence of toxic gases induce far-reaching effect on the health of people.

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BIOFUEL

Row over subsidy in Indonesia

TERRY LACEY

The Indonesian government, confronted with a collapse in demand for biofuels and resistance from state fuel distribution company Pertamina to continue to sell biofuels at a loss, is pushing a proposal through the House of Representatives to allocate $71 million dollars to subsidize locally produced biodiesel and bioethanol.

However this proposal is being delayed in the Indonesian Parliament.

Indonesian lawmakers Alvin Lie and Effendi Simbolon, members of parliamentary Commission VII overseeing the energy and mining sector said legislators were suspicious of the role of the Indonesian Biofuel Producers Association (APROBI) which attended the parliamentary session, questioning who would benefit from the subsidy, the people or the biofuel producers.

But Paulus Tjakrawan, APROBI's secretary general said producers had been selling to Pertamina at a loss.

Indonesian petrol and diesel prices at the pump are low, because of low global oil prices, as well as Indonesian fuel subsidies on petrol and diesel.

Evita Legowo, Director General of oil and gas at the energy and mineral resources ministry explained that subsidized biodiesel and bioethanol would be mixed in with the allocated quotas for subsidized Premium gasoline and diesel.

State fuel distribution company Pertamina has been ordered by the government to mix at least 1 percent biopremium fuel with subsidized gasoline and up to 5 percent of biosolar with subsidized diesel.

The average subsidy works out at 1,000 Indonesian Rupiah per litre (about 10 US cents) but this is only paid out when the biofuel price is higher than the fossil fuel price.

The government is trying to underpin a weak biofuels industry which has been hard hit by low oil prices and recent fluctuations, since mid 2008, in the price of palm oil (CPO).

Only bioethanol from sugar cane or cassava can now reach the market without a subsidy whereas biodiesel from CPO and jatropha needs a subsidy if Pertamina is to continue distribution.

Hilmi Panigoro, Chairman of the Indonesian Renewable Energy Society, whose family founded the Medco Group, involved in oil and gas and energy, recently criticized the lack of follow up after initial euphoria on biofuel development in 2006. He said that investors were now confused and discouraged.

His main criticism alleged a lack of clear government coordination and failure to provide effective leadership to drive all the related stakeholders into action.

Unggul Priyanto, director of energy resource development at the Agency of Assessment and Application of Technology (BPPT) also said that "Biofuel development is just floating around without leadership".

The now defunct National Team for Biofuel Development previously had no authority to enforce policy.

This related to a more fundamental problem, exacerbated by the negative impacts of the global economic slowdown, as to how Indonesia could make the transition from a command economy led by an authoritarian figure like Soeharto to a modern democracy led by President Susilo Bambang Yudhoyono and still succeed to push new energy policies through the complex decentralized state bureaucracy, and attract investors.

The government has mandated that by 2025 biofuel consumption must contribute at least 5 percent to the national energy mix, from less than 1 percent now. But the country is only producing biofuels at 10 percent of existing capacity, whilst power stations prepared to use biodiesel cannot obtain reliable supplies.

Meanwhile, Indonesian lawmakers are holding back their agreement to the new subsidy policy amidst murmurs about collusion with producers and heightened sensitivities on government fuel and energy subsidies during the run up to the Indonesian general elections in April and presidential elections in June.

It is expected that the Indonesian Parliament will approve the new subsidies soon and government will try to implement new regulations introduced since September 2008 to make use of biofuels compulsory for commercial businesses, fuel retailers and power plant operators.

However the Indonesian experience shows this is easier said than done, amidst wistful hints that Soeharto would have got the job done!

Terry Lacey is a development economist who writes from Jakarta on modernization in the Muslim world, investment and trade relations with the EU and Islamic banking.