"Utilizing Biomass for Bio-fuels and Chemicals: Opportunities and Challenges"

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Biomass is the only renewable source of organic carbon currently on earth that, when utilized efficiently and optimally, can significantly reduce our present reliance on fossil fuels. Biomass, particularly lignocellulosic biomass, is abundant, inexpensive, and does not compete with the production of food crops. However, the complex nature of biomass and many ill-defined issues related to biomass utilization pose a substantial challenge to the large-scale biomass utilization. While it is technologically feasible to utilize lignocellulosic materials and organic wastes into energy, chemicals and fuels, the costs associated with it need to be lowered and new technologies must be developed at a commercial scale. It also must be demonstrated that a commercial scale biomass utilization process is environmentally sound and sustainable.

The system for utilization of biomass for producing energy, chemicals, and fuels, consists of several steps, i.e. biomass production/procurement, biomass conversion processes, and product upgrading/utilization. Each step has its unique opportunities and challenges, and is dependent of each other. As a supply-chain type system, the success rate of the system will be based on success rate of the weakest step. For developing a biomass utilization system that is successful, i.e. economically and environmentally sound on commercial scale, concerted collaborative programs of scientific R&D endeavors that address the opportunities and challenges in each of these steps need to be executed. Such programs, to be successful, will require the collaborative involvements of researchers from almost every field of studies.

As an example of a process-based research and education in biomass utilization, one thermochemical process, called fast pyrolysis, will be discussed. Fast pyrolysis could be the most promising way to utilize biomass via the formation of an intermediate product in liquid form which is easy to transport. It is the rapid thermal decomposition of organic compounds in the absence of oxygen to produce a liquid mixture, commonly referred as fast pyrolytic oil or bio-crude oil (BCO, which is the primary product), a gas mixture (synthesis gas), and solid (bio-char). By producing BCO liquid, which has the density 8-10 times of the original biomass, fast pyrolysis process, as a distributed process conducted nearby the biomass production source, offers an intriguing opportunity to make biomass easier to transport (as liquid) to a central processing facility. At the central processing facility, like petroleum crude oil, BCO then can be used as feedstock for the production of power, chemicals, and/or transportation fuels. This presentation will focus on process engineering and sustainability/environmental aspects, including research opportunities/challenges, in developing a fast-pyrolysis-based biorefinery for utilizing biomass to produce value added bio-based products.

Biosketch: Dr. Justinus A. Satrio is an Assistant Professor of Chemical Engineering at Villanova University in the State of Pennsylvania, U.S.A. He received his Bachelor's and Master's of Science in Chemical Engineering from Iowa State University, U.S.A. He then worked as a chemical process engineer both in Kansas City, Missouri and Jakarta, Indonesia for 4 years before returning to Iowa State to pursue at Doctoral degree, also in Chemical Engineering. His last position at Iowa State University prior to joining	

Villanova in 2010 was Associate Scientist and Research Program Manager at the Center of Sustainable and Environmental Technologies (CSET), a research and development center focusing on thermochemical technologies for converting biomass to bio-energy, fuels, and chemicals.

At Villanova University, in addition to teaching chemical engineering and sustainability engineering courses, Dr. Satrio has developed a very active research program in the area of biomass utilization. He was the founder and the director of Villanova's Biomass Resources and Conversion Technologies Laboratory (BRCT). His research program at BRCT is focused on non-catalytic and catalytic thermochemical processes, such as fast pyrolysis and gasification. Many of Dr. Satrio's research projects are performed in collaborations with researchers within and outside Villanova from various disciplines, including Chemistry, Biology, Environmental Engineering and Mechanical Engineering. From his work, Dr. Satrio has authored and co-authored over 20 publications.

Since joining Villanova, Dr. Satrio has been supervising 2 Doctoral Students, 5 Master's students and over 35 undergraduate students working on various research projects on biomass conversions. He has hosted student research interns from several universities in the U.S.A and from Germany. He has been serving as reviewers of research proposals for various agencies in the U.S.A. and International and of technical manuscripts for several international technical journals. Recently he has been appointed as an Associate Editor of Applied Bioenergy Journal, a new open technical journal published by De Gruyter. Dr. Satrio is an active member of the American Institute of Chemical Engineers (AIChE) and the American Society of Engineering Education (ASEE)