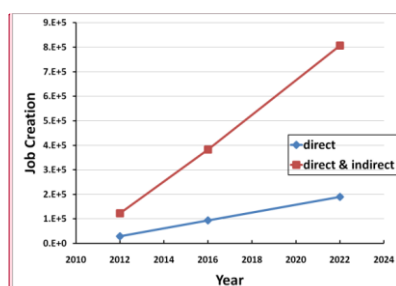


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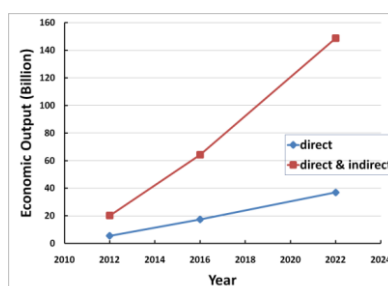
Bridging the Gap between Biofuel Research and Education

By PI: Q. Peter He, Department of Chemical Engineering, Tuskegee University

It has been argued that advanced biofuels industries will have significant impact on the U.S. economic recovery by and its transitioning it to a sustainable green economy. The U.S. National Academies have identified renewable energy to play an important role in a national scientific strategy aimed at replacing the oil-based refinery and transitioning to a green economy- (Augustine, 2005) [1]. In addition, a study by conducted by the Biotechnology Industry Organization (BIO) showed that advanced biofuels industry industries will have significantly impact on job creation and economic output in the near future as shown in Fig. 1 (BIO, 2015). [2].



(a)



(b)

Figure 1. Impact of advanced biofuels industry on (a) job creation and (b) economic output.

(Adapted from BIO, 2015 Ref. [2]).

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Please note that I have made changes to your document to improve readability and clarity. Please go through all my changes carefully. However, if you think that some edit is not apt, please feel free to get back to me. I will be glad to assist you and provide suggestions.
Finally, I wish you the very best going forward and look forward to working with you again.

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Also note that only the first and last names of the author is required. So please revise the author name.

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**IBSS PARTNERSHIP:
BRIDGING THE GAP BETWEEN BIOFUEL RESEARCH AND
EDUCATION**

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Therefore, there is a pressing and immediate national need of skilled engineers and competent researchers in the biofuels field. This need also presents an exciting yet challenging opportunity for ~~the engineers ing educators~~ to expand their mission ~~by~~ addressing biofuels production, and ~~to contributing~~ to ~~the~~ coming wave of change in the industry (Rosentrater & Balamuralikrishna, 2007). ~~{31, 3}~~

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As a member of ~~the E~~education, ~~e~~Extension and ~~o~~Outreach (E2O) team under IBSS partnership, Dr. Peter He at Tuskegee University has ~~ve~~ led a team of students, ~~and~~ in collaboration with Dr. Jin Wang in the Department of Chemical Engineering at Auburn University, to develop a variety of web modules. These modules ~~that~~ provides rich information and knowledge on biomass and biofuels technology for general public and for undergraduate education, ~~and~~ ~~The~~ developed web modules are ~~publically~~publicly available through the project website: www.BiofuelsAcademy.org. The ultimate goal of developing these modules is to support the IBSS E2O team in preparing a technologically advanced workforce and innovative researchers for the biofuels industry.

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Specifically, we have developed a comprehensive glossary of frequently used acronyms and definitions of various specialized terms used in the biofuels industry with hundreds of entries, which ~~provides~~ explanation to common terminologies in biofuels technology. Jargons used in ~~C~~chemistry and chemical engineering ~~details~~ are ~~also~~ included to make ~~them~~ the glossary more technical and job-oriented. ~~So far~~ At the time this paper is being written, we have included more than five hundred terms. This glossary serves as an essential resource for students with little or no biofuels background.

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~~Further, We~~ also have developed a collection of common equipment used in biofuels processes, namely Visual Encyclopedia of Equipment, ~~that~~ which includes ~~a wealth of~~

photographs, drawings, videos, and descriptions of different equipments used in different biofuel_s processes, such as gasifiers, pyrolyzers_s and reformers. This resource ~~also~~ serves as a tool to build up students' biofuel_s background. So far_s, we have developed more than 40 equipment modules. Due to limited space, we can only provide an abridged screenshot of an equipment module as shown in Fig. ~~f~~Figure 2.

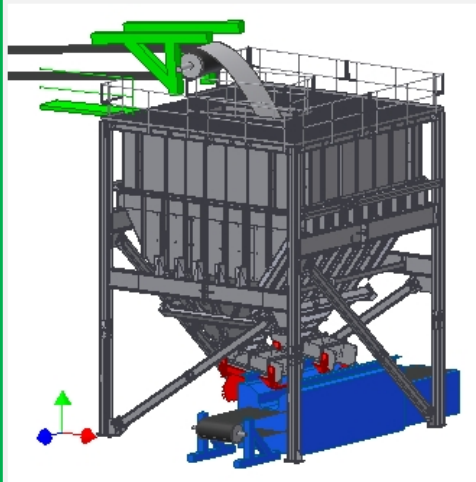
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Hammermill Surge Bin

- Introduction

The primary function of a hammermill surge bin in a biofuel process is to provide a controlled constant feed from a hammermill to a secondary source without taking on the wear & tear of operating a belt feeder associated with the larger sized biomass material, and yet maintain the required mobility. The surge bin is usually mounted on legs to elevate the bin to a height which permits a truck to be driven underneath the surge bin. A gate in the bottom of the surge bin is then opened and the material falls out of the bin into the truck below. Surge bins are often mounted on a trailer for easy mobility from one site to the next.

- Figures



(source: http://www.dicionario-tecnico.com/definicao-significado/surge_bin_71241.html)

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Fig. 2. An abridged screenshot of an equipment web module. Full module can be found at: <http://biofuelsacademy.org/web-modules/equipment/bin-and-storage-unit/hammermill-surge-bin/>

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Additionally, ~~Besides individual equipment~~, we have developed web modules for the different pathways employed by different biofuels processes, including gasification, fermentation, pyrolysis, combustion, and liquefaction. For each pathway, we classify the process based on technology and feedstock. For example, ~~for in case of~~ gasification, we have developed seven web modules based on different technologies and nine modules based on different feedstocks (Fig. ~~Figure 3~~, top). ~~For In case of~~ fermentation, we have developed six modules based on technology and seven modules based on feedstock (Fig. ~~Figure 3~~, bottom). Each module includes

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a technical introduction of the process, ~~the~~ process flow diagram, equipments or reactors, related videos and glossary terms, and references. Compared to a classroom module, ~~which~~ that extracts the same fundamental concepts, such as heat of reactions, from different processes, a process web module ~~is process oriented. In other words, it~~ provides students a complete or holistic description of a process that involves different fundamental principles and concepts, such as mass transfer, heat transfer, and phase equilibria.

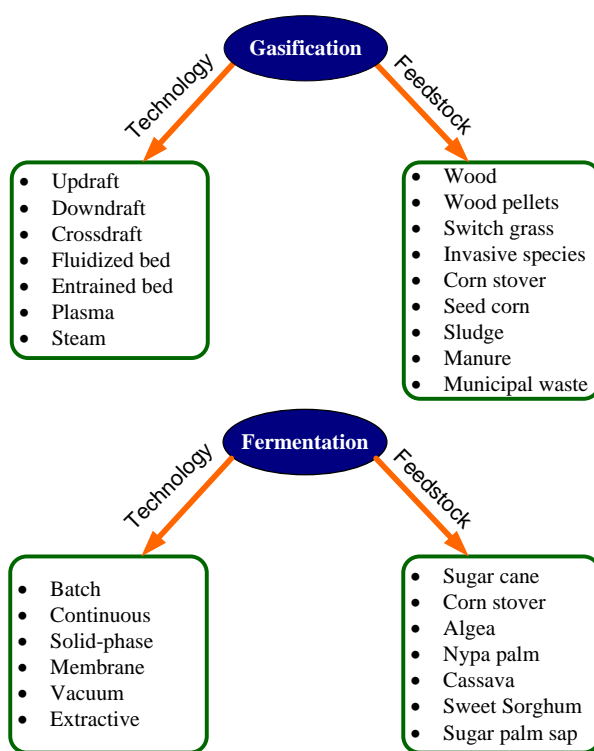


Fig. ~~ure~~ 3. Process web modules based on technology and feedstock. Two examples: gasification (top) and fermentation (bottom).

One example of process module on biogas production is shown in Figure 4.

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Figure 4. An abridged screenshots of the developed web module on biogas production and utilization: including a technical introduction of biogas production, process flow diagrams, equipments, related videos and glossary terms, and references.

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In addition, we have developed animated process video clips for many biofuel process to illustrate instruments such as different types of gasifiers and Fischer-Tropsch reactors and

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~~demonstrate~~ the process material/energy flow and reactions ~~in action, including during~~ combustion, pyrolysis, ~~and~~ liquefaction, ~~different types of gasifiers, Fischer Tropsch reactors,~~ etc.

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The animated videos ~~were created~~ based on process flow diagrams, equipment illustrations, and cutaway drawings. ~~The A-~~video clip provides a vivid description of how a process operates, including the flow of material streams, details of the reactions, energy exchanges, etc. Compared to verbal descriptions, these videos provide students a more intuitive and dynamic view of the process, which could significantly improve ~~the~~ students' understanding ~~of a process~~. All videos are accompanied with narrations and are shared on YouTube. Collectively, they ~~ha~~-ve been viewed more than 14,500 times in the past year. In addition, we have also included more than two dozen biofuel-related videos developed by other organizations.

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Finally, we have compiled a comprehensive reference list, ~~wherein~~ students or general public can find additional information and use for further study. The reference list includes hundreds of books, journal articles, and website links related to biofuels technology.

~~References:~~

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~~Augustine N. R. (2005). The National Academies. Rising above the gathering storm:~~

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~~Energizing and employing America for a brighter economic future. Washington,~~

~~D.C.: The National Academies Press: Washington, D.C., 2007.~~

Biotechnology Industry Organization. BIO. ~~Retrieved Feb-ruary 2015 from~~
~~https://www.bio.org/ (accessed Feb. 2015).~~

Rosentrater, K. A., & Balamuralikrishna, R. (2007). The growing importance of emerging

biobased industries to engineering and technology. *The International Journal of Applied Management and Technology*, ~~2007~~, 16-33.

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~~1.~~

~~2.~~

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