

ISSN: 2688-836X



***Corresponding author:** Elnashaie SSEHE, Department of Chemical Engineering, University of Waterloo, Canada

Submission:  December 12, 2022

Published:  December 14, 2022

Volume 12 - Issue 5

How to cite this article: Elnashaie SSEHE*. Multi-Components (MCs) Renewable Raw Materials (RRMs), Multi-Platforms (MPs) Integrated-Bio-Refineries (IBRs) for Sustainable Development (SD). Nov Res Sci. 12(5). NRS.000799. 2022. DOI: [10.31031/NRS.2022.12.000799](https://doi.org/10.31031/NRS.2022.12.000799)

Copyright@ Elnashaie SSEHE, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited.

Multi-Components (MCs) Renewable Raw Materials (RRMs), Multi-Platforms (MPs) Integrated-Bio-Refineries (IBRs) for Sustainable Development (SD)

Elnashaie SSEHE*

Department of Chemical Engineering, University of Waterloo, Canada

Opinion

IBRs are becoming a very important subject for SD including Bio-Fuels (PFs) and Bio-Products (PBs). The subject has become widespread, not only in biochemical Journals but there are also new IBRs Journals. The state of the art at the present time is one RRM feed stock (e.g.: lignocellulose biomass, such as Rice Straw) and two platforms one biochemical and one (or two) thermal as shown below. The research work can include more types of RRM and more than these 2-3 PFs. It is possible to include earlier work in an integrated manner (membrane and non-membrane fermenters, multi feed stocks RRM, MP, IBRs for control of CO₂ emissions and other wastes to produce biodiesel and bioethanol. In short, what is suggested includes producing BF and PBs using MCs-RRMs feed stocks, including wastes. These feed stocks will include:

i. Biomass formed of lignocellulose from agricultural waste and similar wastes and corresponds to two platforms, one is a biochemical formed of delignification to remove lignin from the lignocellulose. The lignin is used for producing chemicals or as a fuel to maximize the thermal efficiency of this part of the IBR and the remaining is cellulose-hemicellulose and their enzymatic hydrolysis produces mainly: Glucose, Xylose and Arabinose that can be fermented to bioethanol and similar products using Mutated *S.Cervisea* using classical Continuous Stirred Tank Fermenters (CSTFs) and/or membrane fermenters, and /or immobilize packed bed fermenters and/or periodic, aperiodic and chaotic fermenters.

The other platform is thermal, where the biomass is processed through possible two paths:

- a) Fast pyrolysis to syngas, then treating the syngas to remove CO₂ and make it almost completely CO, H₂ mixture suitable for Fischer-Tropsch catalytic reactions to produce different BF and BP
- b) Another thermal process for the processing of biomass is controlled thermal process that produces bio-oil which is similar to fossil crude oil but a bit lighter and is to be processed in a Fluid Catalytic Cracking (FCC) unit to produce fractions similar to that produced from fossil oil (e.g.: Diesel, Gasoline, Kerosene, etc.)

Therefore, the thermal platform(s) can be one of the above or both (2)

ii. Another possible bio feedstock is one of the energy crops, switch grass, which is mainly formed of lignocellulose and is treated in 2-3 platforms as described above

iii. Possible bio feedstock is another one of the energy crops, Jatropha, which is mainly formed of lignocellulose and Lipid. The lignocellulose is treated in 2-3 platforms as described

above. The Lipid is treated as shown later regarding algae to produce biodiesel and bioethanol and the waste of this biodiesel platform is treated in thermal platforms (1-2)

iv. Another possible and most promising for the future RRM is growing algae in a photo-bio-reactor using CO₂ as a feedstock and contributing to CO₂ emission control. A good choice of the strain of the microalgae will give growth rate about 200 times (20000%) higher than the rate of growth of Soybean. The algae produced can produce from its Lipid, through trans-esterification, high quality biodiesel and from the first step waste it can produce bioethanol. The final waste can be used in thermal platform(s) (1-2) as described above. The same process applied to this Lipid from the algae can be applied to the Lipid from Jatropha.

The no. of RRM is:

- a. Biomass, e.g.: Agricultural Waste, Municipal Waste, +=2+ (More than 2 types of Biomass)
- b. Energy crops, e.g.: Switch Grass, Jatropha, +=2+ (More than 2 types of Energy Crops)
- c. Algae, e.g.: Artificially grown in Photo-bio-reactor; natural Algae in sea/ocean shores and lakes, += 2+ (More than 2 types of Algae)

Total = 6+++ (more than 6 types of RRM)

For each RRM we need 2-3 platforms, and then this novel IBRs can be formed of 12-27 platforms depending upon RRM and platforms chosen. This is a much larger no. of platforms than the present IBRs formed of 2-3 platforms and based on 1 RRM.

The change of the raw materials to RRM will require change of the processes and will need novel bioreactors of novel configurations (e.g.: CSTF with and without selective membranes & packed bed immobilized fermenter with and without selective membranes, etc.) and/or different modes of operations (e.g. Steady State, or periodic or aperiodic or chaotic, etc.). The first stage of research can be exploratory with a limited budget and therefore the proposal at this stage can be only the first phase of such a large and ambitious project. The present proposal with 6+++ RRM and 27++ platforms and all what is in between. This preliminary investigation will concentrate on Material and Energy (ME) balances and Modeling, Simulation and Optimization based on available experimental, pilot plant and industrial data. The Objective function for Optimization will be based on Maximum Production Minimum Pollution (MPMP), Economics and Sustainable Development (SD). The jump from MPMP to SD will depend upon the use of RRM that makes the processes Sustainable. For MPMP is a necessary condition for Sustainability, what makes it sufficient is RRM.