Lignocellulosic Bio Decomposition : A Green Solution in Coal Mining Areas

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***Abstract*— Coal mining leads to environmental damage which can be controlled to some extent with many green solutions. Beside this many problem are cumulative and to be tried combindly and continuously. Wherever, the feasible solution having sustainability may be adopted rigorously. Coal mining areas specially open cast coal mining resultant degraded land due to air, water and heavy metal exposure. Moreover, due to surface and forest clearance for opening the coal pits loss of vegetation or trees occurs which finally affects the availability of fuels for cooking and other purposes. In order to solve these problems a green solution was sorted out with the help of available bio-waste e.g. agricultural waste, forest litter, washery and fly ash waste which can be bio- decomposed for lignocellulosic component and resultant green energy and nutrients. Both this can be helpful and environmentally sustainable.**

***Index term*— Lignocellulose, pyrolysis, laccase, termite, municipal waste.**

I. INTRODUCTION

Coal mining resultant air, water and land pollution which can be minimise to some extent with many available green technologies. The overall damage can be seen on land as open cast coal mining excavate and open pits for extracting coal resulting ultration of land, soil pollution due to addition of heavy metals and land degradation due to loss of fertility and dumping of over burden dump materials having lack of soil particles. To overcome this problem soil has to be improved by increasing fertility [1]. Open cast coal mining remove surface vegetation, agriculture and forest tree affects the availability of fuels for cooking purposes in and around coal mining rural areas. An alternative arrangement has to be thought by bio decomposition of lignocellulosic materials as solid waste available in coal mining areas [2]. These lignocellulosic materials may be in the form of agriculture, municipal, forest, washry and fly ash as a waste available in and around coal mining areas. This material can be biodecomposed by many means and using termites [3] for the same is an innovative idea and green approach also.

Bio decomposition resultant both energy and decomposed material contains readily available nutrient supports plant growth improves fertility in soil. By this heavy metal pollution can be minimise and land can be improved by addition of this decomposable material. This review article discusses all this in brief.

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II. SOURCE OF LIGNOCELLULOSIC MATERIALS

Coal mining is more than 70% done through open cast resultant, many solid waste constituents of lignocellulosic type. In and around open cast coal mining activity agricultural, municipal, washry and thermal power waste as fly ash were generated in huge quantities. Beside this open cast coal mining removes huge quantities of vegetation, trees, forest litter resulting loss of huge biomass [4].

However, these bio decomposable biomasses which are the great source of lignocellosic material can be wisely utilised for conversion of energy and available soil additative or amoliarant [5]. Open cast coal mining brings many subsidiary industries along with its own development resultant expansion of population around us. Population resultant municipal waste which are huge source of lignocellulosic waste easily converted also for energy and soil amoliarant. Another big source is knight soil or human excreta for methanification and ultimately energy production [6]. The left over can be used as soil additive.

Beside this the aquatic plants e.g. algae and water hyacinth grown as waste in fresh or waste water is another potential source of energy and soil additive for sustainable development [7].

III. BIO DECOMPOSITION PROCESS

PYROLYSIS

Pyrolysis used for pre treatment of cellulose decomposes into gaseous and char treated with a temperature greater than 300^{o} C [8], resulted in 80 – 85% conversion of cellulose to reducing sugar with more than 50% glucose. The process can be enhanced by carrying out in the presence of oxygen[9].

A. MECHANICAL COMMINUTION

Comminution of lignocellulosic material through combination of process e.g. chipping, grinding and milling applied to reduce cellulose crystallinity usually with size of 10 – 30 mm, after chipping and 0.2 – 2 mm after milling and grinding[10].

B. STEAM EXPLOSION

Steam explosion most commonly used method for the pre treatment of lingo cellulosic materials[11]in which bio mass is treated with high pressure saturated steam an pressure is

suddenly reduced resultant and explosive decompression. At a temperature of 160^{o} – 260^{o} C for several seconds to few minutes before the material is exposed to atmospheric pressure [10].

C. biological pre treatment

This involves rot fungi [12], a safe and eco friendly method does not require high energy for lignin removal from a lingo cellulosic bio mass require extensive lignin degradation [13]. Lignin degradation by white – rot fungi occurs through the action of lignin degrading enzymes such as peroxidise and laccase[14] effective for biological pre treatment of lignocellulosic material[15a,b].

IV. TERMITES FOR BIO DECOMPOSITION OF LIGNOCELLULOSIC WASTE

Termites as wood – feeding approaches, cellulolytic action attributed to symbiotic gut flora[16a,b] resultant of cellulytic enzymes feeding a lignocellulytic biomass[17a,b]. Termite digest lignocellulosic compounds due to the enzymes present inside the guts. Present as exogenous enzymes from micro organisms. Termites divided into feeding groups i.e. wood feeding, dry- wood feeding, wood and litter feeding, soil feeding, fungus growing and grass feeding termites. The termite guts provide a very distinct ecological environment which accommodates very specialised cellulolytic and hemi cellulytic microorganisms. The association between certain xylophagus termites and their hind gut protozoa is the fascinating and frequently cited. Example of nutritional symbiosis[18].

Termites utilize wood waste as a source of food shows that cellulose and hemi cellulose were degraded with efficiency of 59% to 99% fermented anaerobically by the protozoa or directly by the termite on cellulolytic enzymes to acetate, carbon dioxide and hydrogen gas. Acetate is subsequently absorbed by the termites and used as their major oxidisable energy source [19]. The hydrolysis of cellulose is a complex process which requires at least three cellolytic enzymes[20]. Hemicellulose is digested by termites with high efficiency of 49- 78% more over xylans as polysaccharide made from units of xylose, building blocks of hemicelluloses chain [21]

V. FUTURE SCOPE

With the increasing trend in industrialization more energy will be required to meet both human as well as industrial growth. Growth trend require more land for habitat as well as industrial expansion to meet the verge of modernization [22]. Every inch of land will be precious and reserve of coal will also be limited resultant in the search of alternate energy source. These option rely on utilization of all lignocellulosic waste material to be converted into energy and nutrient additive for improving waste land. This will help in green solution or zero waste management for sustainable development. Utilization of fossil fuel for meeting energy demand is an old trend. Alternative biomass energy source as a solid waste e.g. algae, water hyacinth agriculture, municipal solid waste or washery, thermal power waste and over burden dump top material etc will be the best lignocellulosic source to be decomposed through termite or other method of decomposition for optimal energy source and soil additive[23]. This will help in improvement of wasteland created by open cast mining and an alternative energy source for development.

VI. CONSTRAINT

Lignocellulosic biodecomposition of available solid waste in coal open cast mining areas requires intensive effort to meet energy and fertility demand. A very systematic and wise effort with proper management is required. This will require a huge source of fund in beginning to start the process. Moreover, this will requires huge quantity of solid waste containing biodegradable lignocelluloseic material economically viable[24].

The left over biomass or digestible biomass has to be recycled for utilization as additive or fertilizer or manure to improve the health of soil or land. This require very intensive marketing system within farmers. A slight disorder will fail or collapse whole system and huge pile of waste material will be stored having great threat to environment [24].

VII. CONCLUSION

Bio-decomposition of lignocellulosic waste available in coal open cast mining area must be accessed properly to achieve green energy and additive for improvement of waste land. Otherwise mismanagement result into reserve environmental effect. Utilization of lignocelluloses waste through biodecomposition by termite and other process will help in generating green alternative energy resources beside fossil fuel, which will be economical as well as sustainable.

The left over biomass after extraction of energy will be a good soil additive improves waste land or polluted soil affected by mining, utilised for agriculture or growing fruit or forest tree species. In both the case green sustainable environmental condition may be achieved to minimise the pollution load in coal mining areas.

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