ENERGY SUSTAINABILITY – AN ISSUE FOR TODAY

L.E.N Ekpeni[1*], A.G Olabi[2]
[1,2]*Biofuel Research Group, School of Mechanical & Manufacturing Engineering, Dublin City University, Collins Avenue, Glasnevin, Dublin 9, Ireland.*
[*]*E-mail: leonard.ekpeni3@mail.dcu.ie, leonardo55en@yahoo.com*

Abstract

Energy sustainability has been an area of greater growth in terms of development across the globe in the recent time. This is said to improve further in the future from one country to another. This development through sustainability needs a cleaner energy supply and renewable energy sources [RES] that are affordable which will not in any way interferes with the society negatively. Most suitably among the [RES] are the biomass and waste fuels which are considered to be a sustainable form of energy due to the fact that natural resource materials renew themselves at a frequent rate so that the ability of future generations to utilize bioenergy will not be compromised. Biomass is a concentrated solar energy that are obtained from the solar powered photosynthesis process during the growth and development phases of plant materials and through which their conversion techniques; waste to energy techniques, bioenergy are the resultants produced from the source, like; biogas, bioethanol, bio hydrogen etc.

In this research, biogas production through yeast (baker's yeast) is being considered as it is used in the High Pressure Homogeniser (HPH) and its significant energy production is also analysed as compared to other biomass materials that are convertible to different form of biogas such as agricultural crop, crop residues, and forest products.

Keywords: Renewable energy, Biogas, Crops, Biomass, Sustainability, RES, HPH, Yeast

1. Introduction

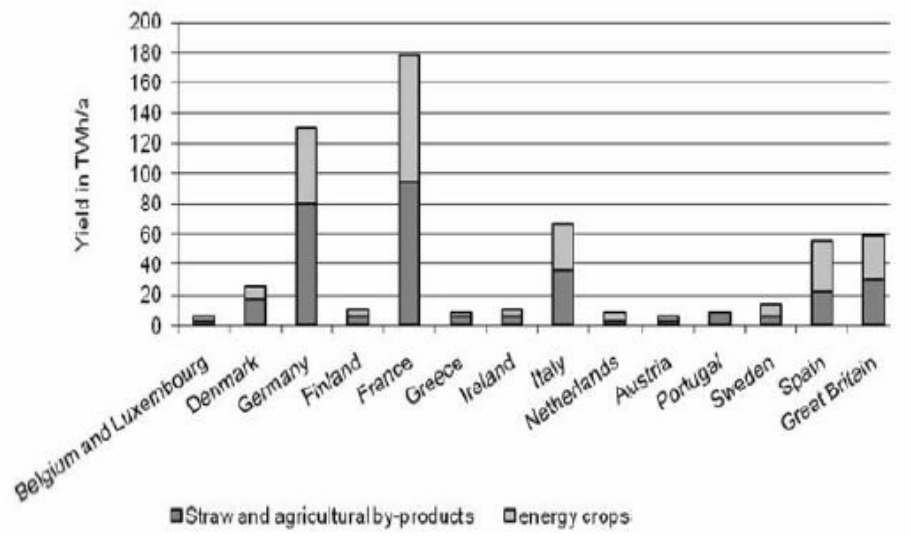
Fossil fuel and its combustion may eventually leads to the enhancement of global warming and greenhouse gas effect as claimed by Svante Arrhenius in 1896, is no longer an issue. Energy sustainability in general, has now been considered as the major key in terms of natural resources management, and this involves operational efficiency, environmental impact minimisation as well as socio-economical issues (Brennan and Owende, 2010). This has become a necessary issue for discussion for every individuals across the globe because, the global energy demand has been growing rapidly, and it is assumed that about 88% of this demand is being met by fossil fuel presently wherein these fossil fuels are being considered as oil and their products, natural gas and coal (Ionel and Cioabla, 2010).
In meeting the increasing demand of bioenergy, several raw materials will need to be considered in the production of biogas and bioethanol (Petersson et al., 2007). and several factors has accounted for this renewed development. The world population has been on the increase, it has doubled since 1960 and will be expected to have more than trebled to almost 9 billion by 2050 as it currently stands at above 7 billion mark (Curry and Pillay, 2012), hence in the same vein, the

energy demand will increase by a factor of two to three during this century (Ionel and Cioabla, 2010).
Also, [RES] only supply 14% of the world energy demand (UNDP, 2000), and since [RES] is otherwise known as the alternative energy sources, increasing the consumption of fossil fuel to meet out current energy demands alarm over the current energy crisis has generated a resurgence of interest in promoting renewable alternatives that will meet the development of world's growing energy needs (Youm et al., 2000; Horst and Hovorka 2009). It is anticipated in the scenarios of the future development as highlighted by (Schmid, 2008). that the usage of biomass for energy purposes will be insufficient in providing the world's energy demand outside the fossil fuel, hence sustainable development now requires methods and and tools in measuring and comparing the environmental impacts on human activities for various products (Dincer, 2001). It is now thought that continuous usage of fossil fuel which has be on the increase, will not only lead to diminishing rate of its reserve but also, lead to adverse environmental impact, which has now be showing in most recent times across the globe, especially in the areas of health risk and changes to the climate currently being experienced.
In compliance to the Kyoto protocol agreement which came into force in 2005, minimising the emission rate of greenhouse gas (GHG) emission has been the primary focus and then shifting to renewable energy source that will be sustainable is another. In other to minimize related global warming and climate change impacts, this GHG emission must be reduced to less than half of global emission levels of 1990 and that the energy supply must be secured since these oil and gas reserve concentration are in regions in the world that are politically unstable (Weiland, 2010).
In this research, biogas production through yeast (baker's yeast) is being considered as it is used in the High Pressure Homogeniser (HPH) and its significant energy production as bioenergy from renewable sources is already today a viable alternative to fossil fuels. In a period like this or in the near future when fossil fuel (hydrocarbons) are likely to become scare and costly, methods to convert biomass to competitive liquid biofuels are now increasingly attractive (Sahin, 2011), as in the use of the HPH wherein bakers' yeast are applied.

1.1 Biogas as renewable energy source for sustainable future

Apart from HPH wherein yeast is used as part of biogas production through the homogenization of yeast for the release of protein which aid in the biogas production. This form the major part of this research, others are those that are produced through aerobic and anaerobic digestion of biomass materials and agricultural products including waste and other organic material contents that can produce lignocellulose materials that result in biogas production. Anaerobic digestion (AD) has been considered as a process through which a complex mixture of symbiotic microorganisms transforms organic materials under oxygen-free conditions into biogas, nutrients, and additional cell matter, leaving salts and refractory organic matter (Wilkie, 2005). AD of organic wastes is an effective technology for both treatment and energy conversion. This is widely used as a renewable energy source as the process produces a methane (CH_4) and carbon dioxide (CO_2) rich biogas which are suitable for energy production, and that in return will help in replacing fossil fuels (Ionel and Cioabla, 2010). Production of biogas through anaerobic digestion has been known to provides significant advantages over other forms of bioenergy production and has also been evaluated as one of the most energy-efficient and environmentally beneficial technology for bioenergy production (Fehrenbach et al., 2008).

Most countries across the globe has adopted and implemented biogas as way towards the future sustainance. The development of the biogas production has varies from one country to another. For example in Europe, countries like France, Germany, Italy, Britain and Spain have had it more developed than as in countries such as Denmark and Sweden which do not put as much emphasis on the use of biogas, in those countries, using of other types of other renewable energies (wind, solar) being considered more favourable (Ionel and Cioabla, 2010) as depicted in fig (1), but recently, the situation has now been changed in terms of agricultural biogas plants development; for these countries; Germany, Denmark, Austria and Sweden, they have now taken the lead, while there has been improvement to a certain level for these countries; the Netherlands, France, Spain, Italy, United Kingdom and Belgium and technological development currently under way in these countries like Portugal, Greece and Ireland as well as in many of the new, Eastern European member states, wherein large biomass potentials has been identified (Holm-Nielsen et al., 2009) because of these development, numerous governments around the world mostly within the OECD countries have resulted in supporting the market introduction of biomass for energy purposes (bioenergy) since the last decade (Lamers et al., 2011).

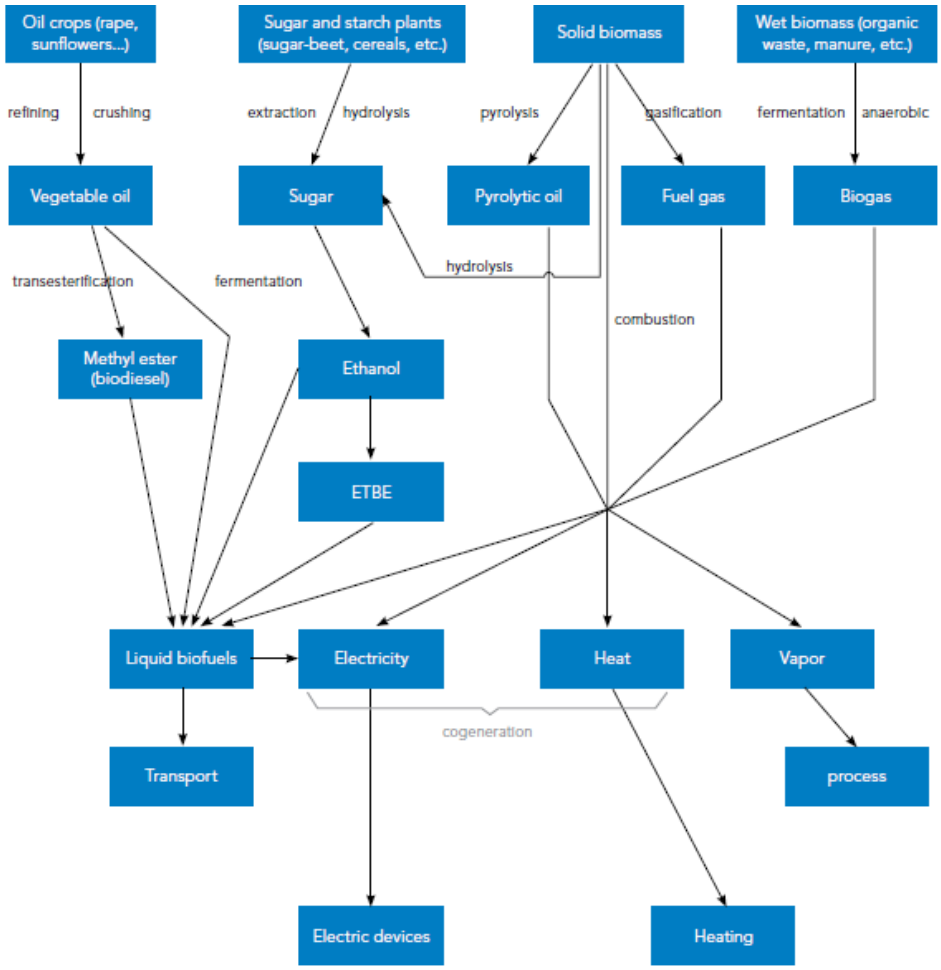


- **Fig. 1:** Biogas production in Europe (Lamers et al., 2011)

In view of the plan for sustainable future, this is in maintaining a delicate balance between human need so as to improve the lifestyles and feeling of well-being and preserve natural resources and ecosystem on which we and future generations depends on (Isife, 2010). This will be the kind of development that will meet the needs of the present without compromising the ability of the future generations in meeting their own needs. In realising these potentials of the future needs, there must be stability between human activities and the natural world, wherein the need of the future generations prospects to benefit from the quality of life that will surpasses that of the present is not jeopardized (Isife, 2010). This is one of the renewable energy sources when compared with others, that has grown at a very fast pace across the globe through the continous availabilities of its materials. This improvement has been stemmed to the fact that there are several raw materials and digestion technologies are available for the production of biogas. This

variety and the various fields of application for the biogas and digested product result in great differences in the environmental performance among the potential biogas systems (Panwar et al., 2011).
As a result of biogas cleanliness and environmental friendly nature, its technology is said to provide an excellent opportunity for mitigation of greenhouse gas emission and global warming reduction through substituting firewood for cooking, kerosene for lighting and cooking and chemical fertilizers (Panwar et al., 2011), hence its systems are considered to be strong alternatives to the traditional space heating systems in rural Turkey (Panwar et al., 2011) and have been known to be economically viable when compared with other traditional heating systems (Tademirolu, 1991).

1.2 Biomass conversion technologies



- **Fig 2:** General overview of biomass energy conversion (www.globalproblems-globalsolutions-files.org)

The current energy supply globally are dominated by fossil fuels which is about 80% of the total use of the over 400 EJ per year and about 10 - 15% of this demand is known to be covered by biomass resources, making it the most important renewable energy source that is used to date

(Faaij, 2006). In the industrialized nation of the world, 9-13% of biomass is contributed to the total energy supplies as against fifth to one third percent in the developing countries (Faaij, 2006). There are various means by which biomass can be converted technologically into power, heat and fuels for potential use and these various bioenergy conversion processes are as shown (www.globalproblems-globalsolutions-files.org., Faaij, 2006). Bioenergy are thought to consists and be classified into solid , liquid and gaseous fuel and which are used in one form or another in an energy demanding machinery. Several of these technologies for converting the bioenergy are commercial today and others are being piloted or in research and development (www.globalproblems-globalsolutions-files.org). Biomass sources are numerous these includes forest, agricultural, and livestock residues short rotation forest plantations, specialist energy crops among others, these then come as solid fuels (chips, pellets, briquettes, logs) as liquid fuels (biodiesel, bioethanol) and as gaseous fuels (biogas, synthesis gas, hydrogen) (Sims, 2004). Biofuel resources are classified based on their production technologies and resources of biomass (Demirba, 2011); the primary resources of biomass are produced through photosynthesis and are taken directly from the land; they include residues from the harvest of agricultural crops and trees from forest, while the secondary biomass resources result from the processing of primary biomass resources physically, chemically or biologically, and tertiary biomass resources are the resultant of the post-consumer residue streams such as the used vegetable oils, fats and greases (www.globalproblems-globalsolutions-files.org). Commercial energy production from biomass for industry, power generation or transport fuels makes lower and very important contribution in the modern bio-energy about 7 EJ/year while total production of biofuels mainly through ethanol produced from sugarcane and cereals and corn surpluses as well as oil seed crops to a lesser result in 18 billion litres per year (Faaij, 2006).

As part of this conversion technologies for production of power and heat, biomass power convert renewable biomass to heat and electricity applying the same process as that with fossil fuels and through combustion, gasification and digestion means and transport fuels through fermentation, gasification and extraction means.

Combustion as a conversion technology for biomass in the production of heat and electricity or combined heat and power (CHP) has been considered. This has really come in place in reducing the traditional use of wood which is considered to be having low efficiency aslo as 10%, hence technological development has led to the strongly improved heating systems that is characterised with automation and catalytic gas cleaning with the use of standardized fuel (Faaij, 2006). This is used as a domestic heating for home use and has been a major market for biomass in countries such as Austria, France, Germany and Sweden. Also in use is the CHP and district heating whose system shows an increasing trend, with apparent advantages from higher electrical efficiencies and low costs (Hillring, 2002).

Through converting biomass into a gas and then made available for broader range of energy devices, the process involved in this way is called gasification, this work by heating the biomass in an environment by the gasifier and the solid biomass breaks down to form a flammable gas, the gas can then be cleaned up to have the chemical compounds removed (www.globalproblems-globalsolutions-files.org).

Other to be considered here is the digestion anaerobically of biomass, this has been the most commonly sought conversion technology means for biomass. This is because the needed materials are cheap and are within reach in terms of cost, coupled with the fact that it is very environmental friendly and cleaner when compared to others. Though it is in overall low in

electrical efficiency when the gas produced is used to fuel gas engine driven generator (about 10 – 15%), but can this time reach 35% in its gas conversion, depending on the feedstock used.
Denmark and Germany have strong position with advance digestion system used for processing various wet waste streams (Braber, 1995). Landfill is another considerable choice of biomass conversion technology as the production of methane rich landfill gas from landfill sites makes a huge contribution to atmosphere emissions of methane. (Faaji et al., 1998) viewed the process of landfill gas utilisation as that with significant benefits in that useful energy carriers produced from gas contribute to the build-up of methane GHG in the atmosphere, this has stronger impact compared to the CO2 emitted from the power plant, and the process is presently attracting GHG mitigation within the EU, North America and of increasingly importance across other countries. This has not only been the oldest biomass conversion technology into biogas but has still been the most commonly used method of waste disposal worldwide and after solid wastes have been deposited in a landfill; physical, chemical and biological processes then occur that will modify the waste (Robeck et al., 2011).
As speculated that biomass is one of the [RES] having the capability of increasing the contribution to the world's energy supply in the future through the various biomass conversion technologies. The roles of bio-energy will depend on its competitiveness with fossil fuels and on agricultural policies worldwide, and its contribution is expected to increase in growth to 300 EJ from the current 40 – 55 EJ (Faaij, 2006, Faaji et al., 1998). Biofuel production through the biomass conversion technologies was also consist of the first- and second-generation technologies; the first-generation biofuels are those fuels produced via processes like extraction, hydrolysis and fermentation, as well as transesterification and chemical synthesis and whose fuel resultants are from such sources; vegetable oil, starch, animal fats and sugar. Second-generation technologies are those that their conversion are still based research and development stage such as the hydro treatment, gasification and synthesis as well as hdyrolysis and fermentation (Faaij, 2006).

1.3 High Pressure Homogenizer

High pressure homogenizer (HPH) has been highly skilled and an advanced technological way of biogas production through bakers' yeast use in the machine. It is extremely used to emulsify, disperse, mix and process the products in various industrial sectors and one of the recent improvements in the design of the product is the ability to work under high pressure (Floury et al., 2004). Different of this HPH machine can deliver to the mangitude of 350 MPa but the APV-Gaullin type which centre of attraction for this research is maximum 60 MPa. This consist of a high-pressure positive-displacement piston-pump which forces the cell suspension via a value unit. The suspension is fed axially into the valve seat, and then accelerate rapidly into a small gap between the valvehead and valve seat. These then leaves gap and turns into a radial jet that stagnates on an impact ring before leaving the homogenizer at such an atmospheric pressure (Kleinig and Middleberg 1996). Many authors and researchers have had different views regarding what the cause of cell disruption and cell breakage is all about in the HPH. Cavitation and shock waves/pressure impulses produced as a result of cavity collapse are responsible for cell disruption was viewed by (Save et al., 1994). while impingement and impact were considered as the main cause of this cell disruption as seen by (Keshavaraz-Moore et al., 1990) turbulence (Doulah et al., 1975)

impingement and shear stresses as the cause (Engler, 1980), mangnitude and rate of pressure decrease (Brookman, 1975) and extensional shear (Ayazi Shamlou et al., 1995).

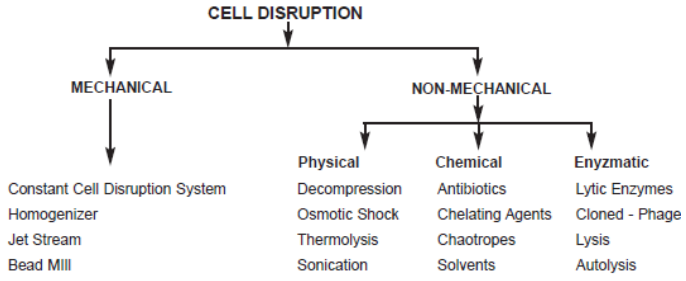
High pressure homogenizer pump delivers flow of liquid at a relatively constant rate irrespective of the pressure set on the valve and there will be some losses during pumping, this losses is dependent on the efficiency of the pump and the product viscosity. In the same vein, the motor horsepower and the pressure rating of the pump determine homogenizer maximum operating. Its valve design for cell disruption has been studied by disrupting cell slurries with different valve configurations. The APV products-homogenizer uses bakers' yeast for the microorganism as a result of its cheapness, nontoxicity, easily obtained as well as its relatively tough cell wall (www.apv.com).

During the experimental performance of the HPH using the yeast suspension, this flows out of the valve, strikes the wall of the impact ring and a plane hyperbolic flow field results through extensional stresses is said to be produced. This is similar to the description of that of the valve rod (Ayazi Shamlou et al., 1995).

1.4 Importance of baker yeast

Yeast use has become a daily phenomenon in the industry and at research centres. Mostly common use is the bakers' yeast (Saccharomyces cerevisiae), has resaonably well known genetic systems and act as a good host to produce desired intracellular material such as the protein. It can be used mechanically and non mechanically through the various cell disruption process.

Yeast cell are regarded as hard to break as they normally needs multiple passes in achieving the high disruption rates required; this process on the ability to extract the valuable contents of the cells in a swift and efficient way (www.labiosystems.com).



- **Fig. 3** Cell disruption methods (www.labiosystems.com**)**

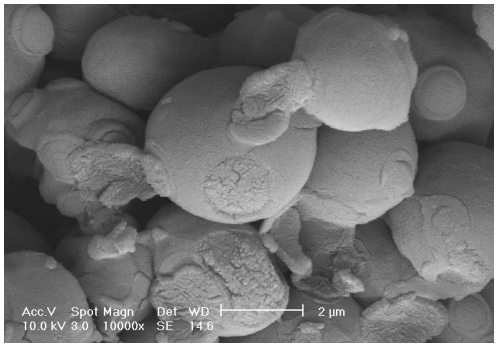


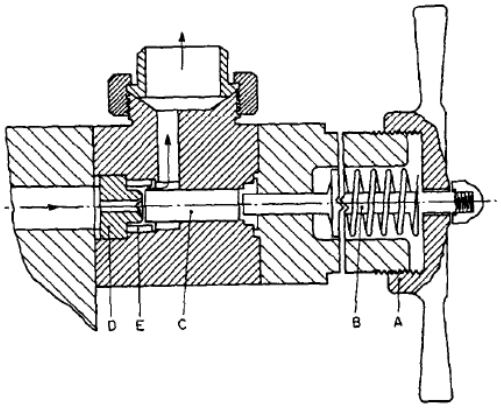
Fig. 4 Yeast cells (www.bren.ucsb.edu)

Because they are widely used in the industry, their cells are in fact used as sources of food, vitamins and growth factors, this is due to the fact that they are cultured for cells themselves, for cell components and for the end products that they produce during the fermentation (Pfaff, 2005). Intercellular material isolation needs the cell to be genetically engineered, so that what would normally be an intercellular product is excreted into the environment. This is normally through physical, chemical or enzymatic means to have this contents released into the surrounding medium (Chisti and Moo-Young, 1986). It has been useful due to its commercial significance and value and it is having a long history as the organisms have been utilized in the fermentation of sugars in rice, wheat, barley in the production of alcoholic beverages as well as in the bakery industries, in these cases, the most commonly used type of yeast is the

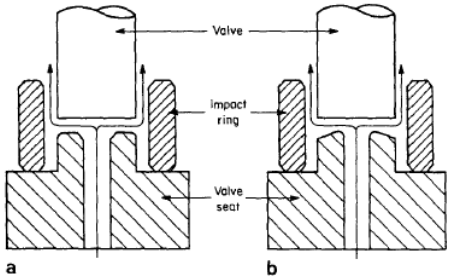
Saccharomyces cerevisiae referred to as the baker's yeast as mentioned previously (Wickner, 1991), where its fermentation gives off ethanol and CO_2 through the sugar that is present in the flour, and most recently as a source of CO_2 which aid the production of biogas due to its high protein contents.

2. Experimental Set-up/Materials and Methods

The experiments were conducted using the conventional APV- Gaulin High Pressure Homogeniser (HPH) and baker's yeast. The supplied baker's yeast was refrigerated for freshness originally and subsequently broken into beaker when ready to be used as it was as a block of fresh yeast, weighing 950g. And using the following composition; the solutions A, B and C where prepared.
Solution A (0.1M KH_2PO_4 + 0.15M NaCl), this is equivalent of 1litre
13.6g of KH_2PO_4 weighed into beaker and dissolved using the deionised water, also; 8.8g of NaCl weighed into beaker and dissolved using the deionised water, both mixed together and filled to the 1 litre mark. This was repeated thrice for 3 litres of solution to be obtained.
Solution B (0.1M K_2HPO4 + 0.15M NaCl),
4.6g of KH_2PO_4 weighed into beaker and dissolved using the deionised water, also; 1.8g of NaCl weighed into beaker and dissolved using the deionised water, both mixed together and filled to the 200 ml mark.
Solution C obtained through gradually adding Solution B to Solution A until the pH scale of 5.3 was attained.725 ml of solution C added to the 950g broken yeast and mixed using the electric mixer. The impact ring valve used here was 9.758 mm in diameter. Since the pump results in the pressure built up, this comes as a result of the piston being powered in the pressure rise (Clarke et al., 2010). Different torque were applied at different time during coupling before the HPH is turned on, lower values are started with, to see the rise in pressure. The mixed yeast when passed through, flow through the compressed entrance known as the gap region and are adjustable through sequential increment by the user and this then, leaves the gap region via the exit way in the direction of the impact ring and then through the outlet (Chisti and Moo-Young 1986; Clarke et al., 2010).



- **Fig. 5.** HPH discharge valve unit, this is controlled by handwheel assembly, A, which through a spring loaded valve rod, B, positions the valve, C in relation to the valve seat, D. During discharge, mixed yeast passes via the valve and its seat and impinges on an impact ring, E (Chisti and Moo-Young, 1986)



- **Fig. 6.** Details of the seat valves (a) 'Flat unit' (b) 'Knife-edge unit' (Chisti and Moo-Young, 1986)

When in operation, HPH was cleaned up and allowed to run for half an hour, then 2 litres deionised water ran through for proper cleaning and when almost completely empty through the conical section, before the mixed yeast suspension (1695 ml) is poured through.
600 ml of the suspension was collected at outlet as waste originally before another 500 ml of the concentrated suspension is taken in a different measuring tube at 40 MPa pressure. This was acceptable for the avoidance of contamination and impurities from the HPH. The hand wheel bar was closed as the pressure was gradually rising over 40 MPa mark to prevent burst up since the maximum on the dial gauge is 60 MPa as the cells in the yeast at that point becomes suddenly deformed under the intense pressure, making the slurry slightly smaller. As the pressure rises, the cell expands which will result in the cell wall rupturing due to the high tensile stresses generated momentarily (Brookman 1975; Shirgaonkar 1998)
200 ml of the solution homogenized was taken and diluted through adding 800 ml of phosphate buffer pH 5.3 (Solution c) to form a solution for protein concentration measurement, this was to ensure that the concentration was same as the composition of the 500 ml of the homogenized sample.
Six 250 ml centrifuge tubes were weighed on the pan; content, tube and cap to 90 g; the content was filled in the tube as diluted and undiluted (3 each) and labelled as such, that is; diluted and undiluted, the equal weight of the tubes was necessary to balance the centrifuge machine as required during the spinning process of the machine and prevent damages being made to set of equipment. The centrifuge set to run at 13,000 rpm for an hour and the temperature adjusted accordingly to the room temperature and on completion, the centrifuged liquids are separated from the solids for protein analysis, while the solid residuals left in the tube after the separation of the liquid are the unbroken yeast cells and debris, and are considered as waste. The separated liquid were emptied into beaker and filtered to test tubes at the rate of 200 ml and 2000 ml of the solutions respectively to three test tubes each labelled as diluted and undiluted with the diluted part mixed by 1800 ml of pH 5.3 phosphate buffer solution. 500 ml of the solution is taken into cuvette with 2000 ml blue biuret solution (protein reagent), and after ½ an hour, the cuvette is placed into the spectrophotometer, but before then, this should be set to wavelength (λ) of 550, position the cuvette so the light beam will pass through the clear sides.

3. Results and Discussions

Ring Size – 9.758, this is the impact ring that lies between the valve seat and the valve head within the HPH. For the purpose of cell disruption, the prepared suspension was kept in a refrigerator at 4° C and this resulted in the optimum concentration of the suspension that was homogenised and collected at 40MPa, to give maximum cell disruption during the

homogenization and after the centrifugation (Save et al. 1994., Save et al. 1997). Table 1 and Figure 7 both indicate the pressure of Yeast released with the applied torque on the impact ring during the homogenisation. The torque applied through the use of wrench was increased in sequence through 1 to 8 and water shows linearity in its plot [figure 7] while the plot for yeast suspension shows an exponential value with $R^2 = 0.9622$. This suggests that increase in the applied torque on the impact ring on the valve seat leads also to an increase in the resultant pressure due to the decomposition of the cell that rupture before exiting the chamber, as there will be need for the cells to maintain high pressure since the cells deformation through direct pressure will not be sufficient because of the elastic and compressible properties of the bakers' yeast (Clarke et al. 2010). Invariably, turbulence plays a very important role in this discussion, as (Doulah et al., 1975) hypothesized it as having the greatest influence on disruption in a homogeniser.

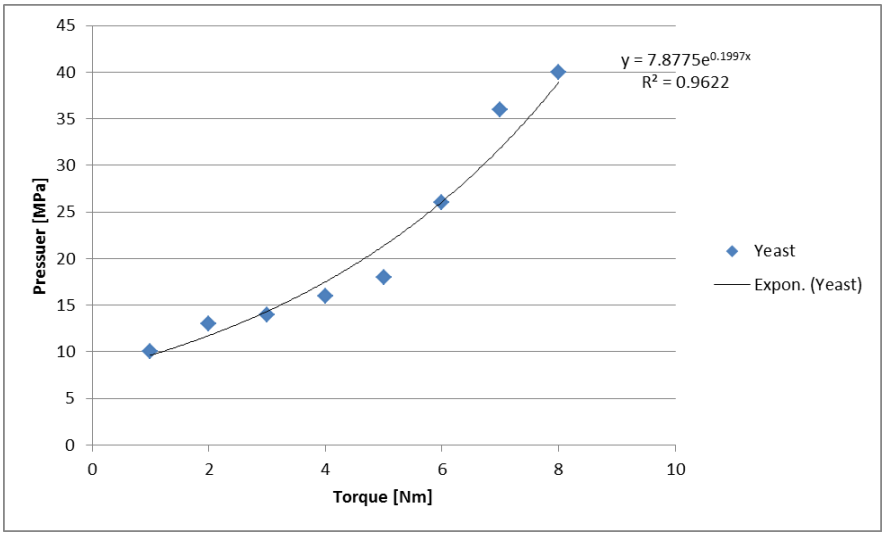
With microbial cell like bakers' yeast it is a different scenario as this will now become complex due to the eddy current that will be involved which will cause the bond to be broken in the form of the Van der wall forces of attraction that is present which on the contrary would not have been able to break down causing fragmentation to the entire cell wall completely even with the applied torque and pressure on the yeast being homogenised.

The rise in the water pressure, should not have been, this happened so due to the clean-up of the HPH after each use of passing the yeast solution through the inlet, gap and exit region. Even though it is cleaned up for about half an hour, there will still be left over of some of the yeast that has not been completely removed and as a result, this will build up cavitation on the HPH which when used on the next level of torque applied, raises the pressure of water. This cavitation tends to drop the water pressure below that of the yeast at a given temperature, wherein bubbles of vapour will form at the nucleation sites tends to be favourable. As the bubble continue its built up, and as the external pressure is applied, there will be time when there will be balance in which the forces tending to enlarge the bubble equates that tending to reduce it as gases are trapped in, this in turn would cause an increase in the pressure of the yeast and so a high pressure comes as a result to oppose the surface tension force tending to reduce its size (Doulah et al., 1975; Clarke et al., 2010).

While in Table 2 and Figure 8, depicts the samples; diluted and undiluted suspension of yeast that has been centrifuged. Both have originally been diluted and the diluted was further diluted by 2000 ml of solution C (Phosphate buffer) at the pH of 5.3 before 500 ml reagent solution was added to both set. These were allowed to stay for half an hour before being passed through the UV Spectrophotometer for protein analysis. When done, the results obtained were as shown in Figure 8 and Table 2. This suggests that the diluted solution had more concentration of protein when brought under the UV spectrophotometer as compared to the undiluted, with greater percentage of protein content released.

Pressure (MPa)								
Yeast	**10**	**13**	**14**	**16**	**18**	**26**	**36**	**40**
Torque (Nm)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

- **Table 1:** Pressure on homogenised yeast with the applied torque on impact ring



- **Fig. 7:** Pressure (MPa) against applied torque (Nm) on impact ring

Table 2: Spectrophotometer Readings: Showing the absorbance rate of protein release (Light Intensity) between diluted/undiluted homogenized yeast

Samples	1	2	3	4	5	6
Undiluted	0.210	0.270	0.323	0.339	0.357	0.423
Diluted	0.781	0.782	0.785	0.799	0.812	0.850

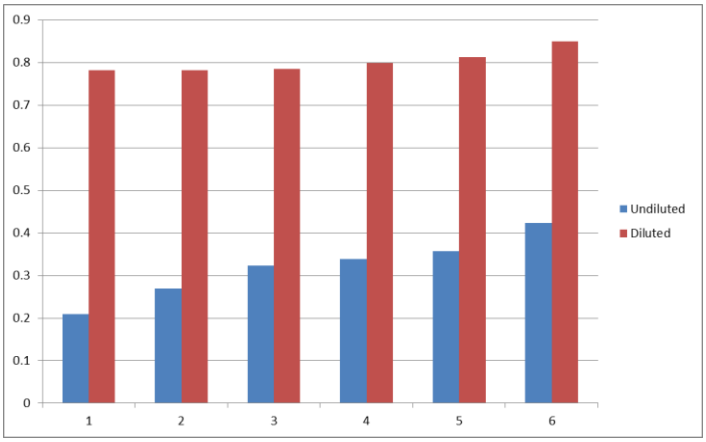


Fig. 8: diluted and undiluted homogenised yeast samples compared after the centrifugation.

4. Conclusion

Energy sustainability is the mainstay of the economy now and in the future across the globe, as no meaningful development can take place without this energy sustainability being addressed. Biogas technology has taken a new turn as it offers a unique set of benefits. It should be understood here that the future starts now when it is being prepared that energy sustainability and technological development be targeted. Biogas has in overall contributed immensely to this energy sustainability and its technological development via biomass. The reason being that it provides a way to treat and reuse various wastes such as; human, animal, agricultural, industrial and municipal (Demirbas, 2011).

In this study, it has been showcased that bakers' yeast is not only useful in the pharmaceutical and drink industries, but has also now proven a point of its usefulness in the renewable energy sector in that it is having a higher protein content which are released during the homogenization process in the (HPH) this in turn aid the production of biogas.

High pressure homogeniser is thought to be the best for yeast and other unicellular organisms in the cell disruption for biogas production but has not been evident or proven that this process of cell disruption do not damage or destroy protein contain in them totally as the more the slurry the suspension is during homogenization, the more the protein content released. In another development, it has been proven to be useful biocatalyst in the investigation of mediatorless microbial fuel cell (MFC) as an active glucose oxidation in a mediatorless biofuel cell. MFC is an electrochemical device that can directly convert the chemical energy of organic compounds into electricity using the catalytic activity of living microorganisms for oxidation of the organic compound (Sayed et al., 2012).

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