to a pair suited for other diseases, the nanoemulsion could be altered in synthesis, or in size, (as it can currently be stable in sizes 30, 60, and 95 nm), in order to fulfill the specific hydro-environments of other diseases in other regions of the body. (Jarzyna et al., 2009)

The incorporation of various natural compounds can facilitate the arrest of cancer cells, and can eradicate the disease from the body. In this study, the natural compound used (name of compound retracted due to proprietary information) exhibits specific biochemical and biological abilities and structure which make it suitable for a cancer drug. This compound is extremely hydrophobic, a necessary characteristic that allows it to be integrated in the hydrophobic PLGA core of monolayer micelle nanoparticles. This compound has a natural ability to induce cell apoptosis through the facilitation of the "caspase cascade" by which cells essentially commit suicide by destroying structure, genetic information, and all other components. This process can be instigated by a single caspase introduction, meaning that very little volume of the compound is necessary in each nanoparticle to induce cancer cell death. This in turn will drive cost of therapy production down, increasing the availability of this therapy to all patients regardless of financial hindrances.

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The Promise of Gasification as an Alternative Energy Resource and the Potential for the Use of Gasification Byproducts.

by Aidan Datené (Junior)

Introduction

In the United States, about 225 million tons of municipal solid waste (commonly referred to as garbage) is generated annually. One third of this waste is either recycled or composted. Landfilling or incineration manages about 150 million tons of municipal wastes. Landfilling faces increasing opposition because of its drastic effect on the environment (Sallam, 2012). Increasing demands for fuels and electricity have coupled with this fear, and a heightened awareness of the influence of various pollutant species (including greenhouse gases) on the global climate system has created the incentive to develop alternative energy sources (Sallam, 2012). The consumption and depletion of Earth's natural resources (minerals, fossil fuels, and ecosystems) has contributed to global warming and loss of biodiversity. The 21st century coming of age science of industrial ecology is defined as the "re-thinking and re-designing [of] industrial activities with full knowledge of their environmental impacts (Themelis, 2007)," and is primed to find sustainable ways of handling the billions of tons of waste solids created by humans (Themelis, 2007).

Gasification is becoming a prominent alternative to landfilling and basic methods of incineration (Butterman, Castaldi, 2008). Gasification breaks down the composition of biomass (biomass is carbon based with organic molecules), plastics, mixed waste materials, and municipal solid waste, and creates a desirable "syngas gas" or synthetic gas along with byproducts including ash and char (Leonard, 2012). Gasification is a thermochemical process that consists of two main stages, not including the refinement of products (Klein, Themelis, 2003). Pyrolysis, the first stage, occurs at temperatures below 600°C (1112 °F). Pyrolysis is the initial gasifying of the feedstock, allowing volatile components (parts of organic compounds) to be released (Klein, Themelis, 2003). This devolatilization process produces volatile gases, char, and ash materials (Pantelides, 2006). In the second stage, the carbon in the ash and char are introduced to and treated with a co-reactant, oxygen, steam (water vapor), or carbon dioxide, resulting in the producer gas "syngas" (Klein, Themelis, 2003). The exothermic reaction in the gasification char and ash, between the carbon and the co-reactant, provides thermal energy that drives the pyrolysis phase. The reactions that create syngas are either endothermic or exothermic, and their rates depend on pressure, temperature, the co-reactant, and co-reactant concentration. The product gas can be used as fuels in steam boilers, reciprocating engines, and combined cycle turbines (Klein, Themelis, 2003).

Gasification products can be controlled; removing metal ions, tars, and oils during the thermochemical process and during the product's refinement, results in a reduction of carbon dioxide emissions (Themelis, 2007). Recovering energy from municipal solid waste in Waste to Energy Plants (such as gasification facilities) can reduce landfilling as well as air and water emissions, further lessening dependence on fossil fuels for power generation (Klein, Themelis, 2003). The produced syngas is primarily composed of hydrogen and carbon monoxide, desirable molecules in creating fuel. During oxidation of biomass the Boudouard reaction ($C+CO_2$ to $2CO$), the Water Gas Shift reaction ($CO+H_2O$ to $H_2 + CO_2$), and the reverse Water Gas reaction ($C+H_2O$ to H_2+CO) take place, resulting in the gain of creating preferable molecules for energy production when refined (GRENWHICH). Refinement includes fuels, notably gasoline, and electricity among others (Butterman, Castaldi, 2008).

The gasification process is a self-sustainable process. Studies have concluded that gasification has beneficial capital gains and is an ecologically ample process. According to a recent study, the gasification process has been seen to cost less per kWh of electricity generated than that of combustion plants (Klein, Themelis, 2003). This attests to gasification's higher efficiency of converting thermal to electrical energy once feedstock components are converted into synthetic gas (Klein, Themelis, 2003). These are encouraging numbers that can cause a prevalent use of the process in place of other, biomass to energy plants.

Gasification of biomass is a growing because of its positive attributes. Biomass maintains a carbon neutral status, meaning it maintains a zero carbon footprint (Butterman, Castaldi, 2009). This makes biomass a prime candidate for gasification because there would be no carbon emissions in any form, when biomass is oxidized during pyrolysis (beginning phase of gasification). Predictions made from current studies suggest that if 20% of liquid fuels were produced from a carbon neutral source, such as biomass, there would be a resounding 15% reduction in CO_2 emissions (Butterman, Castaldi, 2009). Total global CO_2 emissions amount to nearly 29.5 billion metric tons annually. One third of these emissions come from burning gases in the transportation sector equivalent to 1.4 billion metric tons, which so can be averted through fuel replacement alone (Butterman, Castaldi, 2009). A resounding statistic, "for a typical automobile producing 6 tons of CO_2 /per year, this would be equivalent to removing 308 million vehicles from the road annually (Butterman, Castaldi, 2009)" provides great optimism for the future of gasification with biomass as the world looks to control its impact on the environment.

Biomass fuels are globally available (Butterman, Castaldi 2007). Biomass does not have the intermittency associated with wind and photovoltaics (wind and solar converting methods), and they constitute nearly one quarter of the fuel available from municipal waste. Biomass fuels currently provide 3% of the U.S. energy production. Nearly one third of the renewable energy sources in the United States can be attributed to woods, grasses, and agricultural forestry wastes, and residues (Butterman,

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Castaldi 2007). On the basis of a recent study, biomass has been found to be capable for supplying 5% of the nation's power by 2030. Biomass derived fuels have the potential to provide 20% of the U.S. transportation (Butterman, Castaldi 2007).

Currently there are limited uses for the byproducts of gasification, ash or char (Morf, 2012). These byproducts of the gasification process are generally discarded in a landfill (CEWEP). Recently char and ash have been used in construction applications or as an alternate cover for landfills (CEWEP). However, the majority is still discarded. Studies by Morf (2012), Gori (2009), Sallam (2008), and Klinhoffer, Castaldi, and Nzihou (2012), focus on sundry uses for these byproducts and their beneficial properties.

Char is a residue that is produced during the pyrolysis phase in gasification (Klinghoffer, Castaldi, Nizhou, 2012). Char is composed of material from the original feedstock that was not successfully converted to syngas for fuel production. Char has been tested for catalytic properties and performance in an effort to replace commercial catalysts by efficiency serving as a cheaper alternative (Klinghoffer, Castaldi, Nizhou, 2012). This was tested under the hypothesis that char is dependent on gasification conditions. When char samples of biomass gasification are treated with different co-reactants, they release various amounts of carbon (which has been used in catalytic applications), and can chemically convert tars to useful products by breaking down the sample's composition (Klinghoffer, Castaldi, Nizhou, 2012). Results found were favorable; all parts of the hypothesis were confirmed, and optimistic results have char replacing commercial catalysts under certain conditions (Klinghoffer, Castaldi, Nizhou, 2012). Analyzing chars that were created under different temperatures with different co-reactants, (reactants such as water and carbon dioxide were selectively added to the pyrolysis phase), demonstrated that the surface area of char could be modified by changing gasification conditions. Results continued to show that char was able to break down hydrocarbons methane, propane, and to an extent, nitrogen (Klinghoffer, Castaldi, Nizhou, 2012). The char proved high efficiency when breaking down aliphatic bonds present in methane and propane. This performance was measured against two commercial catalysts and the char had superior results between 500 and 900 degrees Celsius (sample H2O-750-60). When not under these temperature constraints, both H2O and CO2 samples under 500 degrees did not provide adequate results, and above 900 degrees Celsius H2O samples experienced sintering; the breaking down of the sample's micoporous network while those that were produced under CO2 did not provide satisfactory results (Klinghoffer, Castaldi, Nizhou, 2012).

Recent advances in recovering precious metals and rare earth elements from bottom ash have been cultivated from municipal solid waste (Morf, 2012). Efforts to recover these metals and elements have recently increased. This is not a relatively new concept. Law and Gordon (1979) found that there were considerable amounts of silver concentrations in bottom ash (38 ± 8 mg/kg). In 1996, Simon wrote a cover article for a Swiss paper stressing the economic potential for valuable metals that are present in bottom ash, "which showed 40-400 times higher levels of Ag [silver] compared to earth crust levels (Morf, 2012)" Although promising at the time, concentration levels were considered too low to make a recovery of the elements and the metals that made the product economically feasible (Morf, 2012).

In recent years, research has continued to find economically sound methods of recovering metals and rare earth metal elements because of the correlation with an increase demand for these metals (Morf, 2012). Among investigated techniques, there is a magnetic separation method and an eddy current separation method used to generate iron metal fractions and non-ferrous fractions (metals that are light weight, have a higher conductivity than ferrous metals, and do not corrode) (Morf, 2012). The conclusions of the study proved that it is feasible to recover metals but in small concentrations (direct recovery). However, there were unexpectedly large annual amounts of heterogeneous solid waste in the substance flow, which hindered the ability to extract precious metals and rare earth elements (Morf, 2012). This is an area that needs further research into finding ways to facilitate effective methods of extracting precious subsidies while maintaining an economic equilibrium. Potentially high market values for these metals and elements provide optimism. A large reduction on environmental impact by means of future waste and resource management systems may be achieved for economic revenue orchestrated by the high trading value of such metals as gold and silver, provided that efforts to develop recovery techniques are sustained (Morf, 2012).

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The Effect of Mindfulness-Meditation Practice on Anxiety Levels Among High School Students, By Jordan Hudock. (Junior)

Hypothesis:

Participation of high school student in mindfulness meditation practice will reduce the average level of anxiety in students.

Purpose:

With the nonstop, always on the go, modern lifestyle almost all of us face, everyday anxiety has become an epidemic. In America, reportedly seventy-seven percent of all people are not able to cope with this stress or manage it in their daily lives (Millar, 2010). An even more shocking ninety-seven percent of college students report that they experience anxiety on a daily basis as described in the same study (Millar, 2010). If something beneficial, not only to the students' stress levels, but also to their concentration and awareness levels, could be implemented in school systems, shouldn't it be? Study after study shows meditation to significantly alleviate anxiety symptoms (Orme-Johnson et al., 2013) along with a reduction in sleepiness throughout the day and an increase in focus and awareness (Lee et al., 2007). If this simple practice could be implemented in schools' physical education classes, imagine the widespread benefits that would take hold. This study will be done to collect concrete data on meditation's benefits when in the school setting.