Green Chemistry in Everyday Life: A Healthy Way of Life

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ABSTRACT *Green chemistry is the new and rapid developing branch of chemistry. The introduction of green chemistry is considered as a counter to the need to trim down the harm of the environment by synthetic products and the procedures used to produce them. Green chemistry could incorporate anything from reducing waste to even discarding waste in the right way. Every chemical waste ought to be disposed of in the best possible way without instigate any harm to the eco-system and mankind. An attempt has been made in this paper to present chosen cases of execution of green chemistry principles in day to day life.*

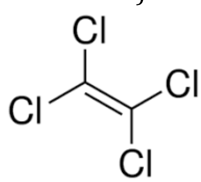
Keywords: *Green chemistry, Environment, Sustainability*

I. INTRODUCTION

Poul T. Anastas (1998) used the term green chemistry first time in a program launched by the US Environmental Protection Agency (EPA) to execute sustainable development in chemistry and chemical technology by industry, academic world and government. The concept of green chemistry includes a new approach (Anastas and Hovarsth, 2007, Ravichandran, 2010, Trost, 1995, Sheldom, 2005, Bharati, 2008 and Ahluwalia, 2004) to the synthesis, processing and application of chemicals in such way as to moderate hazards to health and environment. Green Chemistry is generally described as a set of twelve principles proposed by Anastas and Warner (1998). The principles include guidelines for professional chemists to execute new compound, new processes and new technology. With the expansion of science, green chemistry has changed our life style. This paper presents selected examples of implementation of green chemistry principles in everyday life and in domestic purpose.

II. GREEN DRY CLEANING

Washing with water may shrink or stretch or be spoil in some other way several clothes which are made of fabrics. These clothes should be 'dry-cleaned'. In fact dry cleaning is not dry at all. In dry-cleaning solvents other than water are used to do the cleaning. A colorless and non-flammable liquid 1,1,2,2-tetrachloroethene (known as perchloroethene or PERC) is the most common solvent used in dry-cleaning.



Structure of PERC

The biggest client of PERC is the laundry business. It represents 80 to 85 % of all laundry liquid utilized. Exposure to PERC can take place in the workplace or in the environment following discharges into air, water, land, or groundwater. PERC enters the body when it is breathed in with polluted air or when it is taken with unhygienic food or water. There is less chance that PERC be absorbed through skin contact. After entering in the body PERC can remain there and is accumulated in fat tissue. It dissolves just marginally in water. Most immediate releases of PERC to the eco-system are to air. PERC present in the air breaks down to other chemicals over a number of weeks. Studies confirm that regularly exposed to PERC by breathing or by mouth causes kidney and liver damage and can cause cancer in animals. The amount of PERC present in the environment and the length and frequency of exposure determines the effects of PERC on human health. Individuals who work with PERC all the time will endure the most impacts. Impacts likewise rely upon the health of a person or the condition of the environment at the time of exposure. Breathing PERC over longer timeframes can cause liver and kidney damage in humans. Repeatedly exposure to such environment possess a large amount of PERC can also cause memory loss and perplexity. The levels at which PERC by itself normally found in the environment is not likely to cause any harm. PERC can be part of the cause of the development of photochemical smog when it reacts with different substances in air. When these reactions achieve the upper atmosphere, it can damage the ozone layer. Joseph De Simons, Timothy Romark, and

James McClain developed a technology (known as Micell technology) with use of liquid CO_2 and a surfactant for dry cleaning clothes, by this means supplanting PERC. Dry cleaning machines have now been engineering using this technique. Micell Technology has additionally developed a metal cleaning system that uses CO_2 and a surfactant in that way get rid of the requirement of halogenated solvents (Ahluwalia and Kidwai, 2004).

III. GREEN REMOVAL OF STAINS

Removal of a stain can be an extremely troublesome assignment. Disposing of the stain doesn't involve simply expelling the molecules like detergents. Due to chemical changes stained molecules are no longer reflect light in exactly the same way as before. Removal of stain is called decolorizing or bleaching. Natural stains and in addition a few colors produced from grass originate from chemical compounds called chromophores. Chromophores can absorb light at specific wavelengths and as a result cause colors (Kathryn, 2004). Sodium hypochlorite (NaClO) is a conventional household bleach, acts on a stain through the process called redox reaction. In redox reaction oxidation and reduction occur together; thus one compound is reduced in the process of oxidizing another. Chlorine bleaches are oxidizing agents and reaction of chlorine with water produces hydrochloric acid and atomic oxygen. This oxygen reacts with the chromophores to remove electrons from the molecule. Removal of electrons changes the structure of the molecule and the physical properties that cause the color is changed (Kathryn, 2004).

Chlorine bleaches work effectively and economically. But, occasionally oxidation with chlorine bleaches includes add-on of chlorine atoms to the colored stain molecules instead of just removal of electrons. The accumulation of chlorine to the waste water can form hazardous byproducts, such as dioxins. Dioxins are a group of hundreds of compounds with analogous structure that can bio-accumulate. Waste burning and forest fires are the main sources of dioxins. But, industrial processes such as textile and paper manufacturing which use chlorine can also add dioxins to the environment. Exposure to a lot of dioxins can cause a severe skin disease known as chloracne. Chloracne causes lesions to appear on the face and abdominal area. High exposures to dioxins have likewise been connected to increase cancer threats. Chlorine in large amount is threat to the environment. Other alternatives of chlorine bleaches are also available. The alternatives of chlorine bleaches consist of hydrogen peroxide or solids such as perborate or percarbonate that react with water to liberate hydrogen peroxide. Hydrogen peroxide decomposes into oxygen gas and water as shown in equation (Kathryn, 2004).

$$H_2O_2 \longrightarrow \tfrac{1}{2} O_2 + H_2O$$

During decomposition, H_2O_2 releases free radicals. These free radicals are highly reactive intermediates and oxidize other molecules. By this means, oxidation of molecules of colored stains or pigments takes place; the chemical changes from their oxidation may change their physical properties and making them colorless (Kathryn, 2004).

Hydrogen peroxide is much greener and more eco-friendly substitute to the chlorine bleaching reagents. Though, the supplanting chlorine bleaches with hydrogen peroxide accompanies two issues. The peroxide oxidation process is unpredictable and any molecule can react with the free radicals. The other issue with the use of hydrogen peroxide is the prerequisite of higher temperatures and pressures with longer times to achieve the same results as with chlorine bleaching. In industry, this leads to higher expenses for energy, equipment, and man-power (Kathryn, 2004). Researchers at Carnegie Mellon University developed molecules called tetraamido macrocyclic ligands (TAML) to solve this problem. TAML functions as catalyst in the hydrogen peroxide bleaching reaction. Addition of TAML allows the reaction to accomplish at much lower temperatures and pressures and get superior reaction selectivity (Hall et. al., 1999). TAML-activated H_2O_2 is a perfect example of inclusion of green chemistry for sustainable development. It is made from naturally occurring bio-chemicals, reduces energy costs, and reduces chlorine contamination.

IV. GREEN BLEACHING OF PAPER

As we know that paper is made from wood and contains about 70% polysaccharides and about 30% lignin. The lignin must be completely removed for a good quality paper. In the beginning, lignin is exterminated by setting tiny chipped carves wood into a bath of sodium hydroxide (NaOH) and sodium sulphide (Na_2S). By this procedure around 80-90% of lignin is decomposed. The residual lignin was so far expelled through reaction with chlorine gas (Cl_2). The use of chlorine removes all the lignin to give white paper of high-quality, but causes ecological issues. Chlorine in addition reacts with aromatic rings of the lignin to produce dioxins, for example, 2,3,4-tetrachloro-pdioxin and chlorinated furans. These compounds are cancer-causing agents and cause other health issues.

These halogenated products get their mode into the food chain and lastly into products, pork, beef and fish. In this perspective, use of chlorine has been debilitated. Afterward, chlorine dioxide was used. Other bleaching agents like hydrogen per oxide (H_2O_2), ozone (O_3) or oxygen (O_2) too did not give this the coveted outcomes. A useful agent has been discovered by Terrence Collins of Camegie Mellon University. It includes the use of H_2O_2 as a bleaching agent in the presence of some activators known as TAML activators (Hall et. al., 1999). This activators as catalysts support the conversion of H_2O_2 into hydroxyl ions that are involved in bleaching (oxidation). H_2O_2 enables to break down more lignin at much lower temperature and takes shorter time due to the catalytic property of TAML activators. These bleaching agents are useful in laundry and use lesser water (Tundo and Anastas, 1998).

V. Green Solution for Water Purification

Tamarind seed kernel powder is thrown away as agriculture waste. This is useful to make domestic and industrial waste water clear. Presently Al-salt is used to deal with such water. It has been established that alum raises toxicity in processed water and could cause diseases such as Alzheimer's. Conversely kernel powder is non-toxic, biodegradable and economical viable. In a study, four flocculants to be specific tamarind seed kernel powder, mixture of the powder and starch, starch and alum were employed to treat waste water. Flocculants with slurries were prepared by mixing estimated amount of clay and water. The result reveal that aggregation of the powder and suspended particles were more permeable and enabled water to exude out and become compact with ease and produced larger volume of clear water. Starch flocks then again were observed to be light weight and less porous and in this manner did not allow water to pass through it easily. The results established the powder as an economic viable flocculants and execution of this is close to conventional flocculants such as potash alum.

VI. Conclusion

Green Chemistry is a new methodology that through application and execution of the principles of green chemistry can play a part to sustainable development. Incredible endeavors are still embraced to outline a perfect procedure that begins from non-polluting starting materials, leads to no secondary products and requires no solvents to carry out the chemical reaction or to separate and purify the product. Challenge for the future chemical industry is based on safer products and processes. Consumers can promote green chemistry by insisting safer and nontoxic products from producers. Such demand will likewise help in introducing green chemistry courses in universities, preparing the up and coming age of chemists to consider life cycle effects of the synthetic compounds they design. Governments have a noteworthy part in implementing policies that promote green chemistry innovation and execution in the business segment. In the meantime the chemical industry has an obligation to incorporate the principles of green chemistry into their manufacturing processes while product makers and retailers have a duty to ask chemicals that have been shown to be inherently safe. Implementation of ecologically benign strategies might be encouraged by higher adaptability in regulations, new projects to encourage technology transfer among academic institutions, government and industry for implementing cleaner technologies. Also, the accomplishment of green chemistry relies on the training and education of a new generation of chemists. Students at all levels have to be introduced to the philosophy and practice with regards to green chemistry.

References

1. Ahluwalia, V.K., Kidwai, M. New Trends in Green Chemistry, Anamaya Publisher, New Delhi. 2004.
2. Anastas, P. T., Warner, J.C. Green Chemistry: Theory and Practice, Oxford Univ. Press, New York. 1998.
3. Anastas, P. T., Hovarsth, I.T. 2007. Innovations and Green Chemistry, Chem. Rev. 107, 2169.
4. Anastas, P. T., Williamson, T. C. Green Chemistry: Frontiers in Benign chemical Synthesis and Processes. Oxford University Press, Oxford. 1998.
5. Hall, J. A., Vuocolo, L.D., Suckling, I.D., Horwitz, C.P., Allison, L.J., Collins, T. Proceeding of 53rd APPITA Annual Conference, Rotorua, New Zealand R.M.. April 19-22, 1999.
6. Kathryn, P. Building A Better Bleach: A Green Chemistry Challenge. Chem.Matters. 2004. 17-19
7. Micell Technology, Website: www.micell.com.
8. Ravichandran, S. 2010. International J. Chem.Tech. Res., 2(4)2191.
9. Sheldon, R.A. Green solvents for sustainable organic synthesis: State of the art. Green Chem., 7, 267 (2005).
10. Bharati, V.B. 2008. Concept of Green Chemistry - Redesigning Organic Synthesis .Resonance, 13(11), 1041-1048.
11. Trost, B. M. 1995. Atom economy-A challenge for organic synthesis: Homogeneous catalysis leads the way. Angew Chem Int., Ed., 34, 259.
12. Tundo, P., Anastas, P. T. Green Chemistry: Challenging Perspectives, Oxford University Press, Oxford. (1998).