APPROACH OF GREEN CHEMISTRY IN THE ORGANIC SYNTHESIS

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ABSTRACT

Increasing awareness on the various environmental problems has led a shift in the way consumers go about their life. Sustainable and green chemistry in very simple terms is just a different way of thinking about how chemistry can be done. Over the years different principles have been proposed that can be used when thinking about the design, development and implementation of chemical products and processes. These principles enable scientists to protect the environment and economically beneficial for people and the planet by finding creative and innovative ways to reduce waste, conserve energy, and discover replacements for hazardous substances.

This article presents selected examples of approach of green chemistry in organic synthesis reactions.

Keywords: Green chemistry, Environment, Sustainability.

INTRODUCTION

The concept of greening chemistry[1] is a relatively new idea which developed in the business and regulatory communities as a natural evolution of pollution prevention initiatives. In our efforts to improve crop protection, commercial products, and medicines[2], the present techniques and methods also caused unintended harm to our planet and humans[3]. The term green chemistry was first used in 1991 by Poul T. Anastas in a special program launched by the US Environmental Protection Agency (EPA) to implement sustainable development in chemistry and chemical technology by industry, academia and government. This new approach is also known as:

- Environmentally benign chemistry[4]
- Clean chemistry
- Atom economy
- Benign-by-design chemistry

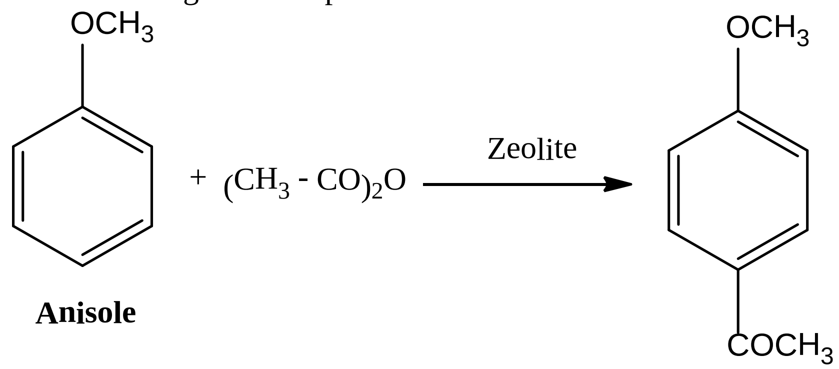
Green Chemistry is based on a set of twelve principles[5,6] proposed by Anastas and Warner. The principles comprise instructions for professional chemists to implement new chemical compound, and new synthesis and technological processes.

Catalysis[7,8] is truly a well-established technology, well proven at the largest volume end of the chemicals industry. For example, in petroleum refineries, catalysts are absolutely fundamental to the success of many processes and have been repeatedly improved over more than 50 years. In comparison to the traditional route of using catalyst, the use of alternative catalyst which are effective and more selective, is one of the goal of green chemistry. Present article put some illustrations which exhibit the way to use of catalyst in the organic synthesis reactions for the benefit of environment[9].

1)The use of a zeolite to catalyze the Friedel–Crafts reaction of anisole with acetic anhydride:-

Acid catalysts, have been widely used in alkylations[10], isomerizations and other reactions for many years and have progressively improved from traditional soluble or liquid systems, through solid acids such as clay, to structurally precise zeolite materials, which not only give excellent selectivity in reactions but are also highly robust, with modern catalysts having lifetimes of up to 2 years. In contrast, the lower volume but higher value end of chemical manufacturing – specialties and pharmaceutical intermediates – still relies on hazardous and difficult routes to separate soluble acid catalysts such as H_2SO_4 and $AlCl_3$

and is only now beginning to apply modern solid acids. A good example of this is the use of a zeolite to catalyze the Friedel–Crafts reaction of anisole with acetic anhydride.



Anisole

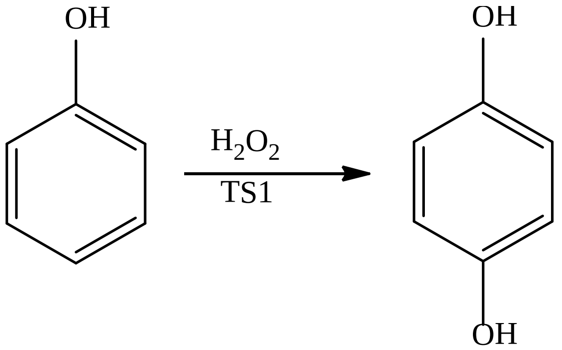
1-(4-methoxyphenyl)ethanone

In comparison to the traditional route using $AlCl_3$, the zeolite-based method is more selective. However, anisole is highly activated and the method is not applicable to most substrates zeolites tend to be considerably less reactive than conventional catalysts such as $AlCl_3$.

2) The use of TS-1, a titanium silicate catalyst for selective oxidation reactions:-

In most of the organic synthesis reactions [11-12] traditional and problematic oxidising agents are used, which we should aim to replace with catalytic systems. Even when catalysts are used, they often have low turnover numbers due to rapid poisoning or decomposition, or cannot be easily recovered at the end of the reaction. Here we need to develop new longer-lifetime catalysts and make better use of heterogenized catalysts, as well as considering alternative catalyst technologies and to continue to improve catalyst design so as to make reactions entirely selective to one product.

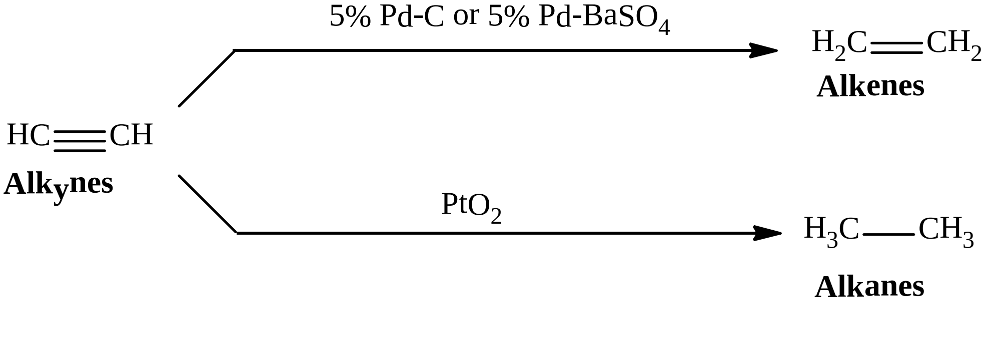
In this context, the development of the heterogeneous titanium silicalite (TS-1)catalyst, by Enichem in the mid-1980s was an important milestone in oxidation catalysis. TS-1[13] is an extremely effective and versatile catalyst for a variety of synthetically useful oxidations with 30% H_2O_2, e.g. olefin epoxidation, alcohol oxidation, phenol hydroxylation a titanium silicate catalyst for selective oxidation reactions such as the 4-hydroxylation of phenol to the commercially important hydroquinone.



Phenol **Hydroquinone**

3) The use of catalyst, in the reduction of alkynes to alkenes or alkanes :-

The catalyst as we know facilitates transformation without being consumed or without being incorporated into the final product. Catalysts are selective in their action in that the degree of reaction that takes place is controlled, e.g. mono addition v/s multiple addition. A typical example is that reduction of triple bond to a double bond or single bond.



Alkynes

Alkenes

Alkanes

In addition to the benefits of yield, the catalysts are helpful in reducing consumption of energy. Catalysts carry out thousands of transformation before being exhausted.

CONCLUSION

In short, Green Chemistry is neither a new type of chemistry nor an environmental movement, a condemnation of industry, new technology, or "what we do already". Green Chemistry is simply a new environmental priority when accomplishing the science already being performed, regardless of the scientific discipline or the techniques applied. Green Chemistry philosophy provides a design for chemical evolution and a guide for scientists to accomplish sustainable practices during chemical research, development, and manufacturing.

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