

## LABORATORY APPLICATIONS OF GREEN CHEMISTRY

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### ABSTRACT

The college chemistry laboratories are examined in the light of the 12 principles of green chemistry (GC). Some feasible applications of the GC to chemistry laboratory are proposed. Parameters like atom economy, toxicity, energy consumption and disposal of waste material are investigated for improvisation. A benign chemistry lab is expected to emerge by modifications in synthetic methodologies, solvents & auxiliaries, feedstock and catalysts. The study suggests the need of modifications in terms of method of working, infrastructure, equipments, glassware and chemicals. One very obvious and expected outcome of the study is that there are plenty of opportunities in making the chemistry benign by implementing all the suggestions in toto.

**Key words :** Green chemistry, Atom economy, Synthetic methodologies.

The twelve principles of Green Chemistry (GC) have drawn the attention of the chemists worldwide<sup>1</sup>. A significant number of leading chemists in U.S., Europe and Japan have diverted their research in the areas of GC. In view of this, a practical demonstration of the utility of the implementation of GC is proposed. An ideal chemistry laboratory, which takes into account all the principles of GC, can really become illustrative. It is desirable to have such a lab at the undergraduate level since the progressive implementation of this can also lead to advancement of GC itself. Thus having such a laboratory can definitely impart the foundation of green practices to a potential chemist.

### Experimental :

The authors are acquainted with the working in the chemistry laboratories of colleges. The study is based on the assumption of similarity in working of these laboratories throughout the country. The twelve principles of the GC<sup>1</sup> were critically examined for viable implementation in laboratories. The features like method of working, infrastructure, equipments, glassware and chemicals were subjected to the present investigation.

### RESULTS AND DISCUSSION

Since the principles of GC are not designed specifically for working of the undergraduate chemistry lab. It was a challenging task to fit them in a niche manner.

The present situation vis a vis the suggested modification in light of principles of GC are discussed as under.

### *Prevention of waste formation is preferred over its clean up:*

It has been observed that practically all the chemicals used for the experiments end up with waste formation in our laboratories. Such waste formation can be prevented by utilization of the synthesized material for the analytical purpose.

In all the colleges, the lab teacher discusses and demonstrates the exercise to be carried out by a batch of students. In some cases, because of either lack of attention on student's side or ambiguity in explanation by the teacher, the whole batch of students carry out an experiment, which does not give expected results and the chemicals get wasted, hence the chances of waste formation are more in this methodology. In addition to present methodology, the use of virtual laboratory (computer programs) should be done to impart better experimental skills to the students, which in turn will reduce the unnecessary waste formation.

There is an ample scope in studying the relation between equipments, glasswares, chemicals and waste formation. Better quality of glassware and chemicals should be used, by doing this and reducing the volume capacity of glassware and increasing the dilution of reagents, the accuracy of the results will be maintained with lower waste formation. Mouth of all the containers should be reduced as and when practically viable.

E-factor<sup>3</sup> is an important terminology emerged from