

Green Pharmaceutical Practices in Industry: A Review

Christine Gauci, Nicolette Sammut Bartolo, Anthony Serracino-Inglott

Department of Pharmacy, Faculty of Medicine and Surgery, University of Malta, Msida, Malta

email: christine.gauci.19@um.edu.mt

INTRODUCTION

Increased use of pharmaceuticals and awareness of the environment has led to the detection of subtherapeutic concentrations of drugs in the environment.¹ Green pharmaceutical practices when applied in pharmaceutical processes, minimise the environmental impact of the activities related to the pharmaceutical industry.²

AIMS

To identify green pharmaceutical practices applied in the pharmaceutical manufacturing industry.

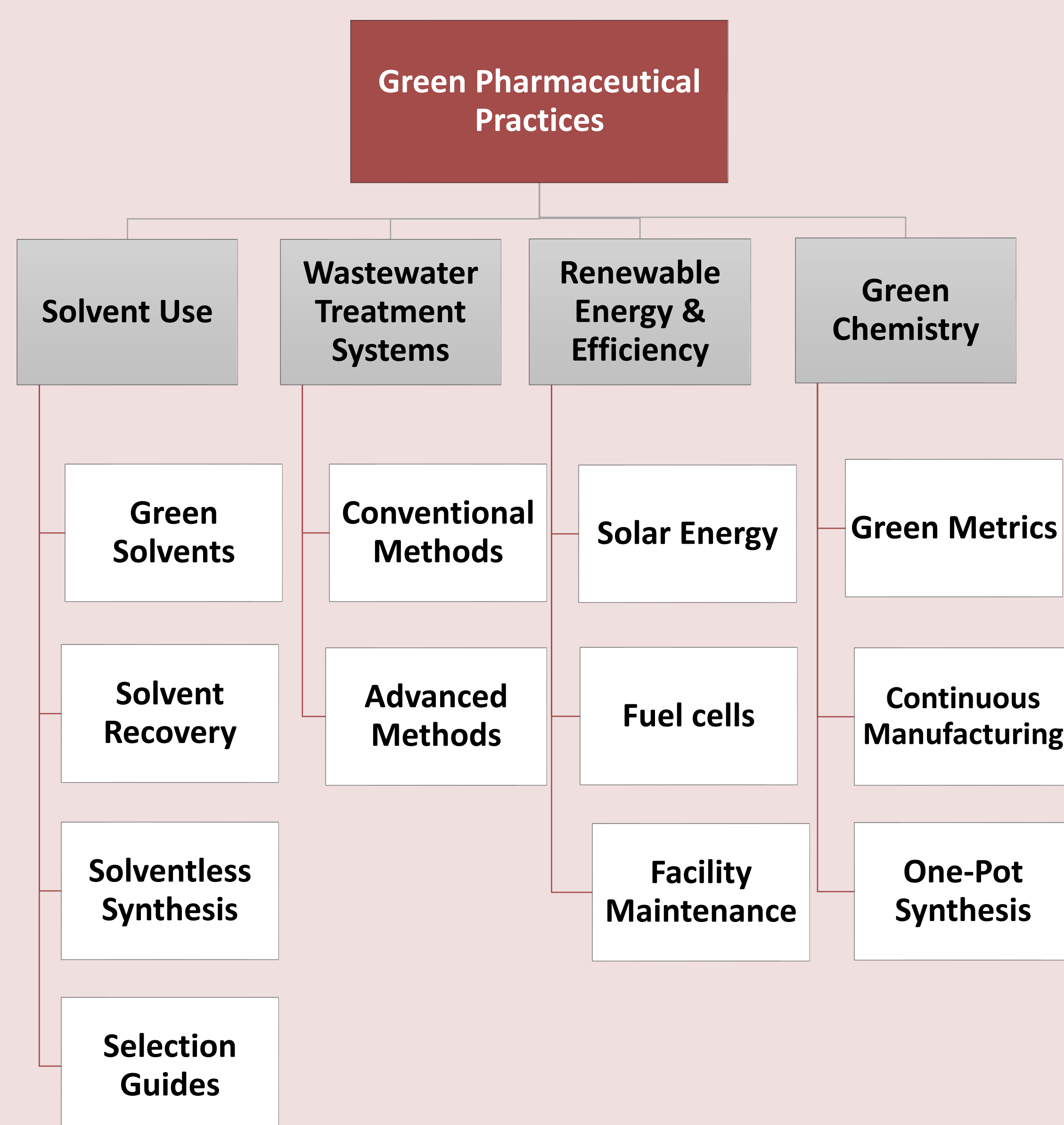
METHOD

A literature review was conducted to identify and evaluate green practices implemented in the manufacturing industry. This was carried out by searching for terms such as “green pharmaceutical practices”, “green chemistry” and “green pharmacy” in Google Scholar, PubMed and Hydi; a collection of databases available at the University of Malta. Articles were analysed according to relevance to the topic in question.

RESULTS

- The 12 principles of green chemistry developed by Anastas and Warner in 1998 were identified as the bases for green pharmaceutical practices.³
- Practices applied within the pharmaceutical industry are related to four groups (Fig 1).
- Solvent recovery and solventless synthesis reduce the use of solvents and related waste generated.
- Green solvents are alternatives to traditional organic solvents providing sustainable options.
- Wastewater treatment systems reduce organic and slow biodegrading contaminants.
- Solar energy and fuel cells provide alternatives to combustion engines and boilers.
- Ensuring facility maintenance such as upkeep of insulation and fittings ensures energy efficiency.
- Green metrics such as atom economy and E-factor allow for the quantification of efficiency and environmental impact of processes.

Figure 1 : Green Pharmaceutical Practices Identified Through Literature Review



CONCLUSION

Different measures along the pharmaceutical product lifecycle are necessary to decrease environmental impact. As the environmental consequences are being made more evident through continuous studies, reports and field testing, enforcement of new legislations is key in ensuring a more sustainable future.

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