Hazardous reagent substitution

Book review

Hazardous reagent substitution: a pharmaceutical perspective

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The large amount of harmful materials generated by the pharmaceutical industry is seen as one of the main reasons for the deterioration of our environment. Therefore, exploring less-hazardous reagents and environmentally friendly pharmaceutical processes have become the focus of research in finding a solution for this problem.

The book *Hazardous reagent substitution: a pharmaceutical perspective* presents the significance of reagent selection and summarizes improving options in today's pharmaceuticals process. Several scenarios are reported in this book, concerning both human health and the environment: (i) to reduce chemical waste by recycling and reusing reagents; (ii) green alternatives should be transmitted concerning sustainability; (iii) several simplified and effective processes are recommended, such as catalysts use, microwave and flow reactors.

Chapter 1 gives an introduction consisting of two main parts: the authors describe the concepts and importance of reagents' properties management and explain the setup of the book. Chapter 2 features the reducing of waste by recycling strategies and benign synthetic protocols. Several innovative synthetic processes from well-known pharmaceutical companies are investigated in detail as case studies.

Reusing expensive but necessary chemicals for some specific systems is discussed in Chapter 3. Among them, recyclable and reusable 4-dimethylaminopyridine (DMAP) derivatives are elaborated on as typical examples. These polymer-supported derivatives are used instead of DMAP during chemical transformation and can be collected conveniently after reactions by simple solid-liquid or liquid-liquid separation. In this way, the activity and stability of DMAP can be maintained meanwhile chemical wastes will be greatly reduced.

In Chapter 4, the recent synthetic advance of atorvastatin exemplifies a very typical production technology of small molecule drugs, which includes asymmetric synthesis and heterocyclic chemistry. The authors summarize and compare three generations in parallel, which improve constantly from hazardous to green processes. Regarding both environmentally friendly and commercially acceptable aspects, bio-catalysis is concluded as the vital revolution for this and even similar processes.

During the development of a drug from the laboratory to the manufacturing field, not only the final product yield but also the safety performance in the scale-up process should be guaranteed and optimized. Different methodologies are illustrated, respectively, in Chapter 5, Chapter 6 and Chapter 7 are concerned with three species of drugs/intermediates. In Chapter 5, the functional solvents ionic liquids (ILs) are proven to be an essential element for raloxifene synthesis, because ILs can keep other dangerous reagents involved in this reaction system under high precaution. Metal coupling catalysis is probed as another feasible solution in Chapter 6, particularly for montelukast sodium synthesis; it is accessed to be the most efficient and safe route after the comparative analysis from earliest medicinal synthesis to large-scale processes. Except for sustainable solvents and catalysts utility, substrate substitution can also promote the greener pharmaceutical processes. Since tetrazole-based chemicals were first reported in 1885, the attention to preparation approaches has been continuously changing due to its wide applications and highly security risks by traditional synthesis routes. From both the raw materials and reaction conditions aspects, Chapter 7 provides a systematic description using azides and diazonium salt to synthesize 1-aryl-1h-tetrazoles separately. The comparison concludes that the latter method is more simplified and safer especially for scale-up processes.

In Chapter 8 the authors summarize the apparent benefits and possible conflicts between academia and industry collaboration. Several significant evolutions of coordinated teamwork are presented in this section. To overcome obstacles and maximize profits, academia could be mainly responsible for innovating ideas and industrial side could offer commercial design and pathways to achieving them.

In conclusion, the authors give a comprehensive overview of hazardous reagents substitution in representative

pharmaceuticals processes. Firstly, sub-titles in each chapter always provide the readers with clear clues; furthermore, understandable synthetic schemes, figures and tables point out improved milestones in contrast to traditional technology; what is more, before the optimal solution is selected for each drug production system, varied studies are addressed from start-up, operation and work-up periods. From this point of view, the most common synthetic methods according to sustainability are covered in this book. Therefore, it can provide a general direction for both chemists and engineers for when they would like to find less-hazardous reagents for some typical synthetic pharmaceutical processes.

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