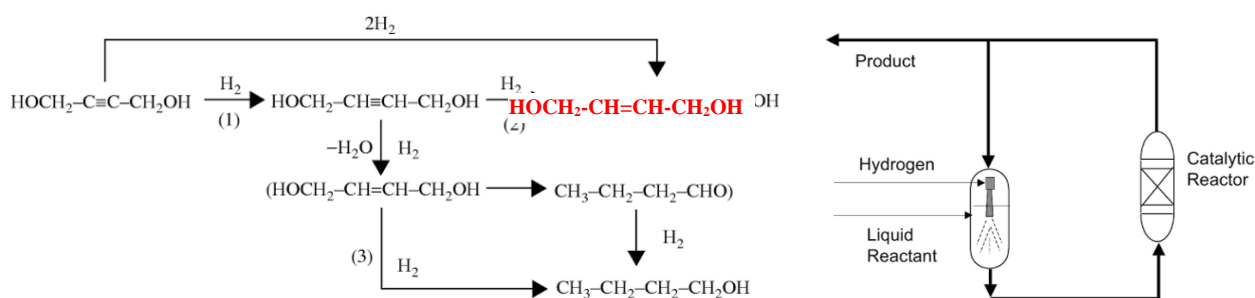


COURSE “Introduction to Green and Sustainable Chemistry”

Written exam – February 04 2017 (Part II)

- 1) In your opinion, how the strategies of PAT and QdB can have a role to reach safer working conditions? Can these strategies be usefully applied to Process Intensification of a chemical plant? Provide examples.
- 2) Discuss briefly with examples which are the main differences in industrial processes (in the use of enzymes and the costs) to produce bioethanol starting from starches or simple sugars rather than from cellulose and hemicellulose?
- 3) There are a number of compounds that have been tested for acting as an estrogen or other steroid mimic and many more that are suggested to be Endocrine Disrupting Compounds. The European Chemical Agency has provided recently a Candidate List of 173 SVHC substances, between these 20 are EDC compounds with an ADI value lower than 0.001 mg/kgbw/day. What the different acronyms means? How the metabolism of a pesticide may be altered as the dose is increased from NOAEL to a dose that produces severe toxicity (i.e. LD₅₀)?
- 4) Few chemicals C-2 and C-3 are considered platform chemicals in biorefinery. Provide two examples for both classes of compounds explaining briefly the metabolic pathway by which they are produced and the main products or materials they can originate by chemical or biochemical transformations.
- 5) How are applied in chemical industry the concepts of Inherent Safety and Inherently Safer Reactions?
- 6) Which are the main differences in applying biocatalysis and biotechnology to the synthesis of a pharma drug on industrial scale? Provide examples elucidating the use of these alternative approaches in the production of 2 relevant compounds, explaining the main advantages and disadvantages.
- 7) What will the Risk Assessment result in? What activities should be conducted during the hazard identification step of the Risk Assessment? Which strategies to reduce risks in an existing manufacturing plant must be adopted in the context of Risk Management?
- 8) What the term VOC means? Discuss briefly with examples the related legislations and which alternatives have been proposed to control or eliminate their use in different industrial sectors.
- 9) *2-Buten-1,4-diol is a compound used in fine chemical industry easily obtained by Palladium catalyzed hydrogenation of 2-butyn-1,4-diol in aqueous solution at elevated pressure of H₂ following the scheme:



As indicated in the scheme, the compound shows consecutive reactions (2) and (3) to give other products. Is the loop reactor indicated on the right an appropriate solution to control the selectivity of this reaction? This loop reactor can represent a process intensification approach? Discuss the pro and con's of the proposed solution.

- 10) * Explain when and why the heterogeneous catalysis and biocatalysis are important in Green Chemistry. The micro technologies can provide further opportunities in this direction? Provide examples to support your opinion in the areas of oxidation reactions.

- 11) * & **A conventional batch process for the production of nitroglycerine ($C_3H_5N_3O_9$) from glycerol $C_3H_8O_3$ and nitric acid (HNO_3) may have a production of 10 to 50 kg of the product at a given time. A) Would you recommend the use of microreactors for the process? B) Can membranes be usefully applied? Defend your answers.
- 12) ** Discuss the following sentence: “Biotechnology seem to be a particularly fruitful area on which industrial sustainability can be based, but so far he has not addressed the problem of public acceptance of agricultural biotechnology”.
- 13) Which is the role of ATP in the cellular metabolism? In/on which part of cell the ATP production via oxidative phosphorylation occurs? Why this molecule is called energy rich phosphoric ester?
- 14) **Alkaloids are one of the three main classes of plant secondary metabolites. Explain briefly why these compounds have (as such or as derivatives) a relevant role in pharmaceutical drugs, identifying two specific products for discussion.

* Responses due by Eng. Chem. Students.

** Responses due by Eng. Environ. Students.