

COURSE "Introduction to Green and Sustainable Chemistry"

Written exam – February 03 2017 (Part II)

- 1) Giving each molecule the same processing experience is considered from some operators one of the generic most important principles of Process Intensification (PI). Do you agree with this position? Provide 3 examples of PI-technologies that, at least partially, address that principle. Motivate (briefly) your choices.
- 2) The ECHA (European Chemical Agency) has provided recently a Candidate List of 173 substances of very high concern (<https://echa.europa.eu/-/four-new-substances-of-very-high-concern-added-to-the-candidate-list>). A) How the toxicity of chemicals is evaluated and B) what the terms endocrine disruptor and SVHC means? C) What factor does not affect Toxicology? a) concentration b) exposure pathway c) species d) geography.
- 3) Discuss briefly with examples the importance of multi-product approaches and supply chain management in a biorefinery industry based on bioethanol.
- 4) For a pesticide based on toxicity studies a NOAEL of 2 mg/kgbw/day in mice is derived. A) Calculate the maximal acceptable concentration in potatoes if per day 200 g potatoes are eaten. B) Define briefly the toxicity terms NOAEL, TLV, ADI, ED₅₀.
- 5) Some C-4 compounds are considered by DOE platform chemicals in biorefinery. Provide the structure of these chemicals and sketch the processes used in obtaining them from representative bio-resources.
- 6) It is opinion of some chemical managers that Process Intensification (PI) targets can be mainly reached by adoption of widespread remote control systems. Do you agree with this vision? In which sense PAT and QdB can aid to found solutions in PI, addressing also to reach safer conditions?
- 7) Comment the sentence: "Green engineering requires special attention to manage resources and products safely and healthy". Which are strategies to reduce risks in a chemical plant and which are the procedures to be adopted in a Safety Life Cycle?
- 8) Industrial volatile organic solvents (VOC) are now included among the reactants under special chemical control in international regulations and REACH EU legislation has proposed to ban some of them. With 2 examples explain the role of solvents in chemical and other industry and what has been proposed for their substitution or elimination.
- 9) *In fine chemical and pharmaceutical processes batch-operated, stirred-tank reactors are traditionally applied. Microreactors and monolithic reactors are nowadays becoming a possible alternative for many such processes. Give (briefly, in bullets) 3 pro's and 3 con's of these reactors in comparison with the conventional stirred tank reactors.
- 10) Explain briefly which is the difference between biocatalysis and biotechnology? Provide examples elucidating the use of these alternative approaches in the production of 2 relevant compounds. There is competition between the two methodologies or are complementary? Explain the main advantages and disadvantages of both.
- 11) * & **Name and describe 5 different roles that membrane can play in a chemical (catalytic) reactor.
- 12) **Enzymes and proteins play essential roles in living organisms. Which are the peculiarities of their structure responsible for the typical function as biocatalysts in metabolism and controlling agents for reproduction? They have a role also in the synthesis of secondary metabolites?
- 13) **Terpenes are one of the three major classes of plant secondary metabolites. Which role these compounds can have in the context of biorefinery? Identify two products for the discussion.

* Responses due by Eng. Chem. Students.

** Responses due by Eng. Environ. Students.