

Environmentally benign and catalytic processes, questions for oral exams 2022

1. Basic unit operation: sedimentation, filtration, flotation, centrifugation, extraction, distillation, adsorption, absorption, crystallisation. Basic principles, typical equipment (min one industrial example each). A suggestion of a suitable separation process for a problem given by the examiner.
2. Define the E-factor and explain it in detail within the different chemicals sectors. Describe the atom economy of the rearrangement, addition, substitution, and elimination reactions. Give one example for each.
3. Purification of industrial wastewaters. Classification of available methods based on the properties of the contaminants. A suggestion of a suitable purification process for a problem given by the examiner.
4. Comparison of the applicability of wet air oxidation and supercritical water oxidation for the purification of wastewaters in the chemical industry. Typical operational parameters (pressure, temperature, oxidising agent), maturity of the technology, reaction rate, applications etc.
5. Membrane processes. Balance equations, typical membrane modules. Classification of membrane processes based on the driving force. A suggestion of a suitable membrane process for a problem given by the examiner.
6. Comparison of membrane filtration processes regarding the operational parameters, types of membranes, operational mode and typical applications. A suggestion of a suitable membrane filtration process for a problem given by the examiner.
7. Supercritical fluids, properties, solubility in supercritical solvents. Explanation of a typical example given by the examiner (extraction of plant product, decaffeination of tea, decaffeination of coffee, particle formation techniques).
8. Basic principles of catalysis (types and their basic properties, activation energy, role of the catalysis in the chemical industry). General description of heterogeneous catalysts (zeolites, metal oxides, supported catalysts).
9. Homogeneous catalysis (basic principles, general catalytic cycle, ligand exchange mechanism, examples of applications). General description of homogeneous catalysts (metal centre, ligands, effects of ligand on the properties of catalysts).
10. Comparison of homogeneous and heterogeneous catalysis (advantages, disadvantages via selected examples). Give an example of how zeolites can be shape- and size-selective. Describe the different types of enzyme specificity.
11. Compare traditional batch and continuous flow chemistry processes (mass and heat transfer, residence/reaction time, characteristic pressure and temperature, scalability, solvents used, advantages and disadvantages)
12. Show typical in-line reaction monitoring methods used for continuous flow systems. How they can help optimise the reaction. Describe possibilities for in-line downstream operations in continuous flow systems.
13. C-C bond formation in a continuous flow system. Show it through the production of raspberry ketone via different synthesis routes.