

Environmentally benign and catalytic processes, questions for oral exams 2019

1. Basic unit operation: sedimentation, filtration, flotation, centrifugation, extraction, distillation, adsorption, absorption, crystallisation. Basic principles, typical equipment (min one industrial example each). Suggestion of a suitable separation process for a problem given by the examiner.
2. Integrated Pollution Prevention and Control directive. Best available technology principle. Explain the concept on a selected example given by the examiner.
3. Purification of industrial waste waters. Classification of available methods based on the properties of the contaminants. 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 waste waters of the chemical industry. Typical operational parameters (pressure, temperature, oxidizing agent), maturity of the technology, reaction rate, applications etc.
5. Membrane processes. Balance equations, typical membrane modules. Classification of membrane processes based on driving force. 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. 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).
8. Supercritical fluids, properties, energetics. Comparison of a pump and of a compressor extraction cycle (practical considerations, energy requirements).
9. Supercritical fluids, properties, solubility in supercritical solvents. Applications of supercritical carbon dioxide micronization (basic principles of RESS, GAS, PGSS techniques).
10. Basic principles of catalysis (types and their basic properties, activation energy, role of the catalysis in chemical industry).
11. Homogeneous catalysis (basic principles, general catalytic cycle, ligand exchange mechanism, examples of applications).
12. General description of homogeneous catalysts (metal centre, ligands, effects of ligand on the properties of catalysts).
13. General description of heterogeneous catalysts (zeolites, metal oxides, supported catalysts).

14. Industrially important homogeneous catalytic transformations (carbonylation, hydrogenation, hydroformylation, aminocarbonylation, cross coupling reactions).
15. Industrially important heterogeneous catalysis (synthesis of ammonia, production of sulfuric and nitric acids)
16. Heterogeneous catalysis (basic principles, general catalytic cycle, ligand exchange mechanism, examples of applications).
17. Comparison of homogeneous and heterogeneous catalysis (advantages, disadvantages via selected examples).
18. Alternative solvents for catalysis (water, ionic liquids, supercritical and fluoruous media, bioliquids).
19. Role of the catalysis in biomass conversion