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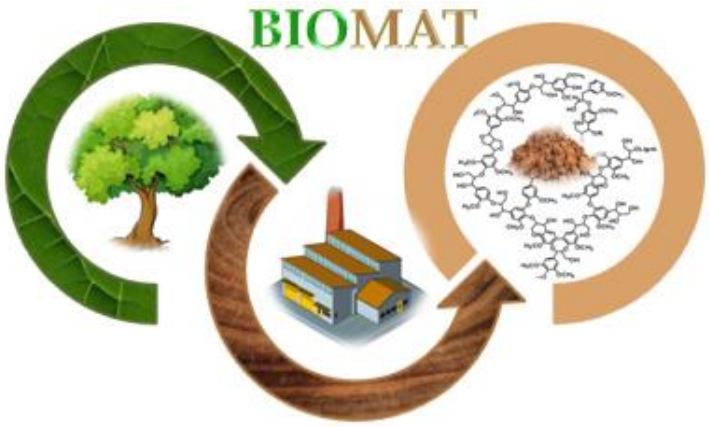

Part 2
E-test

Obtaining polymeric materials with the addition of lignin, testing and evaluation of their properties

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Lublin 2025

Co-funded by the European Union

The e-test was created
as part of the project titled

"Improving teaching competences in the field of designing new generation biomaterials from wood waste "

Project no.: 2024-1-PL01-KA220-HED-000246133
Erasmus+ Programme:
KA220-HED – Collaborative Partnerships in Higher Education.

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Choose and mark one correct answer:

1. Polymers are made of repeating units called:
A. atoms
B. mers
C. micelles
D. macromolecules

2. The degree of polymerization means:
A. the number of atoms in a polymer molecule
B. the number of chemical bonds in a macromolecule
C. the number of mers present in a macromolecule
D. molecular weight of the polymer

3. Polymers widely used in industry include:
A. polyethylene, polystyrene, poly(vinyl chloride)
B. sulfuric acid(VI), ammonia, ethanol
C. cellulose, glucose, fructose
D. polyethylene, glucose, ethanol

4. Secondary bonds in polymers include:
A. ionic bonds
B. hydrogen bonds
C. metallic bonds
D. covalent bonds

5. Bulk polymerization is characterized by the fact that:
A. it takes place in the presence of a large amount of water
B. it takes place in a pure monomer without solvents
C. it requires the use of micelles
D. only occurs at negative temperatures

6. Which initiator is commonly used in suspension polymerization?
A. AIBN (azobis(isobutyronitrile))
B. NaCl (sodium chloride)
C. H_2SO_4 (sulfuric acid)
D. BN (boron nitride)

7. The main function of the protective colloid in suspension polymerization is:
A. initiating the reaction
B. stabilizing the suspension

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C. neutralizing the solution
D. polymer chain expansion

8. Emulsifiers in emulsion polymerization are:
A. fatty acid salts
B. organic dyes
C. reaction by-products
D. heavy metal ions

9. In emulsion polymerization, the main reaction phases are:
A. water-alcohol solutions
B. detergent micelles
C. homogeneous polymer blocks
D. salt crystals

10. Lignin in the synthesis of microspheres plays the role of:
A. stabilizer
B. copolymer component
C. reaction initiator
D. reaction catalyst

11. Adsorption is the process of:
A. collecting substances in the entire volume of a phase
B. collecting substances at the interface of phases
C. chemical reaction in a solution
D. solvent evaporation

12. The substance on which the adsorbate accumulates is:
A. inhibitor
B. adsorbent
C. absorbent
D. catalyst

13. Physical adsorption occurs mainly due to:
A. chemical bonds
B. covalent bonds
C. ionic reactions
D. van der Waals forces

14. Chemical adsorption differs from physical adsorption in that:
A. it occurs only in a liquid-gas system

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B. it is completely reversible
C. it always leads to the formation of a gas
D. chemical bonds are formed

15. The phenomenon of accumulating substances within the entire volume of a material is called:
A. adsorption
B. absorption
C. desorption
D. diffusion

16. Adsorption capacity is defined as:
A. the amount of adsorbate per unit mass of adsorbent
B. the volume ratio of the solid:liquid phases
C. the amount of solvent in the solution
D. the amount of substance dissolved in 100 g of solvent

17. An increase in temperature in the case of physical adsorption leads to:
A. an increase in the degree of adsorption
B. desorption
C. it has no effect on the process
D. re-extraction

18. The main advantage of the static adsorption method is:
A. simplicity of the apparatus
B. possibility of carrying out the process on an industrial scale
C. complete elimination of the adsorbate
D. possibility of using columns with different cross-section diameters

19. The column adsorption method is mainly used:
A. in laboratories
B. in industrial processes
C. only in chromatography
D. in catalysis

20. Adsorption is widely used in:
A. crude oil distillation
B. water and sewage treatment
C. fuel combustion
D. ceramics production

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21. Which feature is characteristic of physical adsorption?
A. formation of chemical bonds between the adsorbate and the adsorbent
B. formation of a monolayer
C. high heat of adsorption (80–400 kJ/mol).
D. the possibility of creating multiple adsorption layers

22. Suspension polymerization is also called polymerization:
A. pearl or in suspension
B. in bulk (in block)
C. in solution
D. emulsion

23. What is the main energetic difference between physical and chemical adsorption?
A. physical adsorption – low heat of adsorption (5–40 kJ/mol), chemical adsorption – high heat of adsorption (80–400 kJ/mol).
B. physical adsorption – high heat of adsorption (80–400 kJ/mol), chemical adsorption – low heat of adsorption (5–40 kJ/mol).
C. physical adsorption – high heat of adsorption (1000 kJ/mol), chemical adsorption – low heat of adsorption (100 kJ/mol)
D. both have a similar range of adsorption heat

24. What percentage of industrial lignin is used in the production of specialty chemicals?
A. about 75%
B. about 25%
C. more than 50%
D. less than 2%

25. The growing interest in lignin applications is due to, among others:
A. the abundance of cheap fossil fuels
B. the search for renewable energy sources
C. the lack of greenhouse gas emissions
D. its high solubility in most solvents

26. One of the properties of lignin is:
A. the ability to absorb UV radiation
B. non-biodegradability
C. low glass transition temperature
D. exclusively hydrophilic nature

27. In medicine, lignin can be used as:
A. flavor enhancer

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B. carrier of active substances
C. food preservative
D. diagnostic dye

28. Unmodified lignin can be used as:
A. raw material for Portland cement production
B. additive, filler, stabilizer, UV filter
C. glucose source
D. protein source

29. The main difficulties in the industrial use of lignin include:
A. homogeneous structure
B. unlimited solubility in water and organic solvents
C. lack of chemical reactivity
D. impurities and structural heterogeneity

30. The BET specific surface area of lignin is typically:
A. 1–5 m^2/g
B. 100–200 m^2/g
C. 500–1000 m^2/g
D. 500–2000 m^2/g

31. One of the strategies for the synthesis of lignin polymers is:
A. sulfonation of lignin without any other additives
B. direct mixing of lignin with other polymers
C. reduction of lignin to glucose
D. complete decarboxylation of lignin

32. Physicochemical methods of removing contaminants do not include:
A. adsorption
B. flotation
C. coagulation
D. biological treatment

33. Lignin is considered as a future material in water purification because:
A. it is highly soluble in water
B. it is cheap, renewable and can be modified
C. it has low reactivity
D. has a crystalline structure

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34. In the agricultural industry, lignin can be used as:
A. a food dye
B. a pesticide carrier and a nutrient loss inhibitor
C. a source of protein in feed
D. as an additive improving feed digestibility

35. Due to its ability to absorb UV radiation, lignin is used in:
A. protective coating formulations
B. lubricating oils
C. technical gases
D. protective materials used in nuclear energy

36. The key advantages of lignin as a precursor of adsorption materials include:
A. wide availability and the impossibility of its modification
B. lack of chemical reactivity
C. high cost of acquisition
D. biodegradability, low price and susceptibility to chemical modifications

37. What structural form of lignin is preferred for applications in columnar adsorption processes?
A. lignin-modified polymer microspheres
B. lignin adsorbents in powder form
C. wood dust
D. quartz gravel

38. In the pulp and paper industry, lignin is used as:
A. an agent improving the mechanical strength of paper
B. a source of glucose in enzymatic hydrolysis
C. a chemical reducing agent
D. saponification reaction inhibitor

39. In the renewable fuels sector, lignin can be processed into:
A. bio-oil by pyrolysis
B. leaded gasoline
C. liquid nitrogen
D. vanillin and hygienic lignin

40. The mechanism of dye removal from aqueous solutions by lignin-containing adsorbents is based on:
A. the formation of bonds and electrostatic interactions between the dye and the functional groups of lignin

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B. physical filtration of adsorbent particles
C. dissolution of dyes in the lipid matrix
D. concentrating dyes on the adsorbate

41. The main limitation of using raw, unmodified lignin as a sorbent is:
A. low solubility
B. excessive chemical reactivity
C. lack of functional groups
D. melting point too high

42. In the cosmetics industry, lignin is mainly used as:
A. paraben ingredient
B. as a tanning accelerator
C. skin moisturizing material
D. ingredient of creams and emulsions with antioxidant properties

43. Sorption of heavy metal ions on adsorbents containing lignin may occur as a result of:
A. coordination and complexation with lignin functional groups containing donor atoms
B. increase in combustion temperature
C. evaporation of metals from the solution
D. only and exclusively the reduction of metal ions to the metallic form

44. In the chemical industry, lignin is a raw material for the production of:
A. formaldehyde
B. cellulose acetate
C. copper(II) sulfate
D. vanillin

45. The process of lignin modification leads to:
A. an increase in the specific surface area and the number of active adsorption centers
B. a decrease in biodegradability
C. an increase in molecular weight without changing the properties
D. reduction of the specific surface area and the number of active adsorption centers

46. In materials science, lignin can be a precursor to:
A. cotton fibers
B. carbon fibers and electrically conductive materials
C. aluminum alloys
D. brass

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47. What spectroscopic technique is most often used to study polymeric materials containing lignin?
A. UV-Vis spectroscopy
B. ATR/FTIR spectroscopy
C. Raman spectroscopy
D. Vis spectroscopy

48. What polymer parameters can be determined by differential scanning calorimetry (DSC)?
A. glass transition temperature, melting point, crystallization temperature
B. only thermal conductivity and density
C. only molar mass and degree of polymerization
D. volatility and viscosity of polymers

49. Analysis of lignin by Fourier transform infrared spectroscopy with attenuated total reflection (ATR/FTIR) allows, among others:
A. polymer melting point test
B. identification of functional groups and assessment of their interactions with the polymer matrix
C. determination of the molecular weight of the polymer
D. determination of the zero charge point of a polymeric material containing lignin

50. The basic principle of the differential scanning calorimetry (DSC) method is:
A. measuring the thermal conductivity of the sample
B. examining the rate of diffusion of adsorbate molecules in the pores of the adsorbent
C. examining the changes in the volume of the sample under the influence of heating
D. measuring the difference in the amount of heat supplied to the sample and to the standard as a function of temperature

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Part 2_ Answer Sheet

E-test

Obtaining polymeric materials with the addition of lignin, testing and evaluation of their properties

Name and surname: ……..……..…… Date: ……..……..……

Points: ……..……/50 pts, Percentages:……/100%

Number questions	Answer	Number questions	Answer	Number questions	Answer	Number questions	Answer	Number questions	Answer
1.		11.		21.		31.		41.	
2.		12.		22.		32.		42.	
3.		13.		23.		33.		43.	
4.		14.		24.		34.		44.	
5.		15.		25.		35.		45.	
6.		16.		26.		36.		46.	
7.		17.		27.		37.		47.	
8.		18.		28.		38.		48.	
9.		19.		29.		39.		49.	
10.		20.		30.		40.		50.	

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Part 2_ Answer Key

E-test

Obtaining polymeric materials with the addition of lignin, testing and evaluation of their properties

Each correct answer: 1 point, maximum number of points to be obtained: 50 points.

1. B	**11. B**	**21. D**	**31. B**	**41. A**
2. C	**12. B**	**22. A**	**32. D**	**42. A**
3. A	**13. D**	**23. A**	**33. B**	**43. A**
4. B	**14. D**	**24. D**	**34. B**	**44. A**
5. B	**15. B**	**25. B**	**35. A**	**45. D**
6. A	**16. A**	**26. A**	**36. D**	**46. A**
7. B	**17. B**	**27. B**	**37. A**	**47. D**
8. A	**18. A**	**28. B**	**38. A**	**48. A**
9. B	**19. B**	**29. D**	**39. A**	**49. B**
10. B	**20. B**	**30. A**	**40. A**	**50. D**

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