

Materials and Mechanics in Medicine | HS2019

Exercise 2 – Solution: Biomaterials II (including lecture from Eric Bartsch)

1. **Your company has given you a membrane of their novel biofilm to test and asks you to do an extraction and direct contact test. The sample is a very thin disc of 3.4cm diameter. How do you set up these tests? Give details about the *amount of culture media, size of dish needed, time of experiment and temperature.***

Solution:

- Extraction test specifies 1mL of extractant fluid per 6cm² of sample. The disc has an area of approx. $9 \text{ cm}^2 \times 2 = 18 \text{ cm}^2$. So it should be immersed in 3mL of fluid for 1 hr at 121 °C. Longer times at cooler temperatures are also possible.
 - For the direct contact test, the disc should only cover 10% of the cells. Therefore, the culture dish should have an area of 90 cm². This would require around 20 mL of media for such a large dish. Toxicants in the direct contact test will be much more diluted, both due to the high volume of media and also due to the time for diffusion of toxicants out of the material.
 - Note: Generally, a dish of 1cm² area contains 0.25mL volume of cell culture medium.
2. **The $\log(P)$ value of the anti-inflammatory drug LICOFELONE is 5. What strategy can be effective to deliver a sustained amount of this drug ?**
 - a. Giving the patient injections every 6 hours
 - b. Incorporating the drug into the aqueous part of a nanoparticle
 - c. Incorporating the drug into poly (vinyl chloride) nanoparticles
 - d. Incorporating the drug into poly (methylmethacrylate) nanoparticles
 - e. **Incorporating the drug into poly (lactic-co-glycolic acid) nanoparticles**

3. **How can you influence mechanical properties of implants?**

Solution:

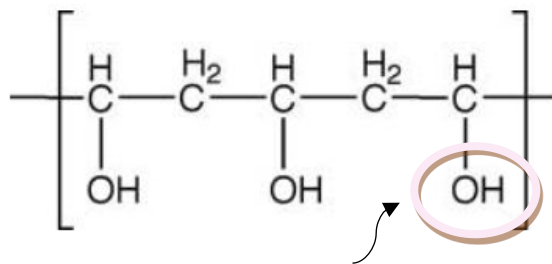
- Material choice (titanium alloy less stiff than stainless steel)
- Different design (stem length, coatings, roughened surface)
- Different manufacturing processes (annealing, cold working)

4. What are the main three advantages of roughened surfaces on cementless implants?

Solution:

- increased contact area
- increased friction for primary stability
- scaffold for bony ingrowth for secondary stability

5. Draw the chemical formula for polyvinyl alcohol and identify the groups which make this polymer water soluble.



OH or hydroxyl group is hydrophilic