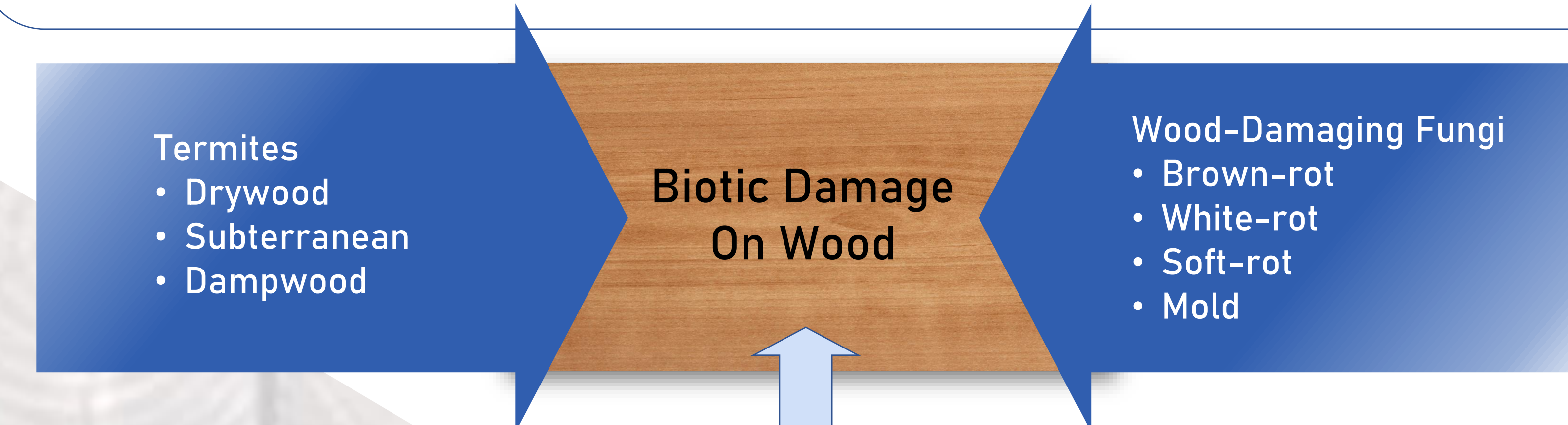
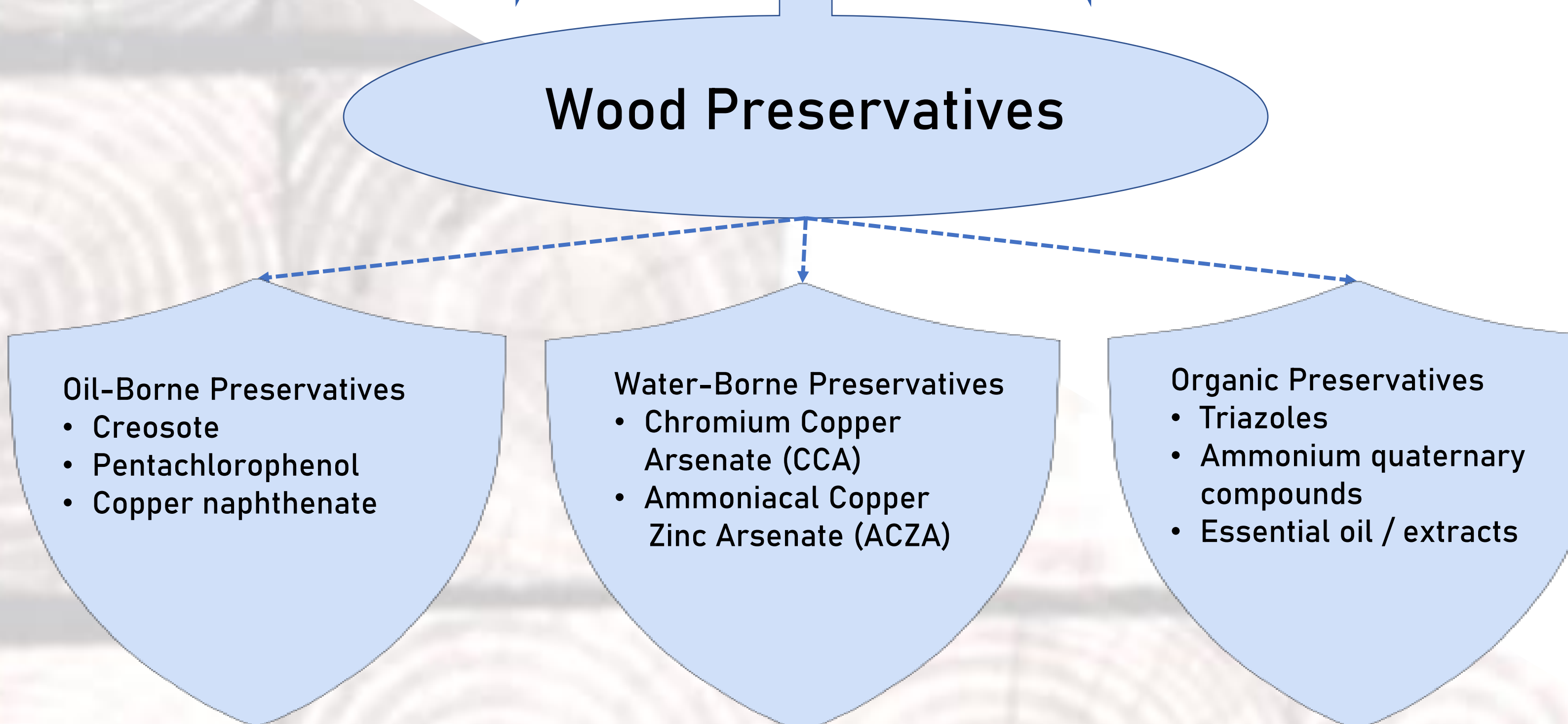
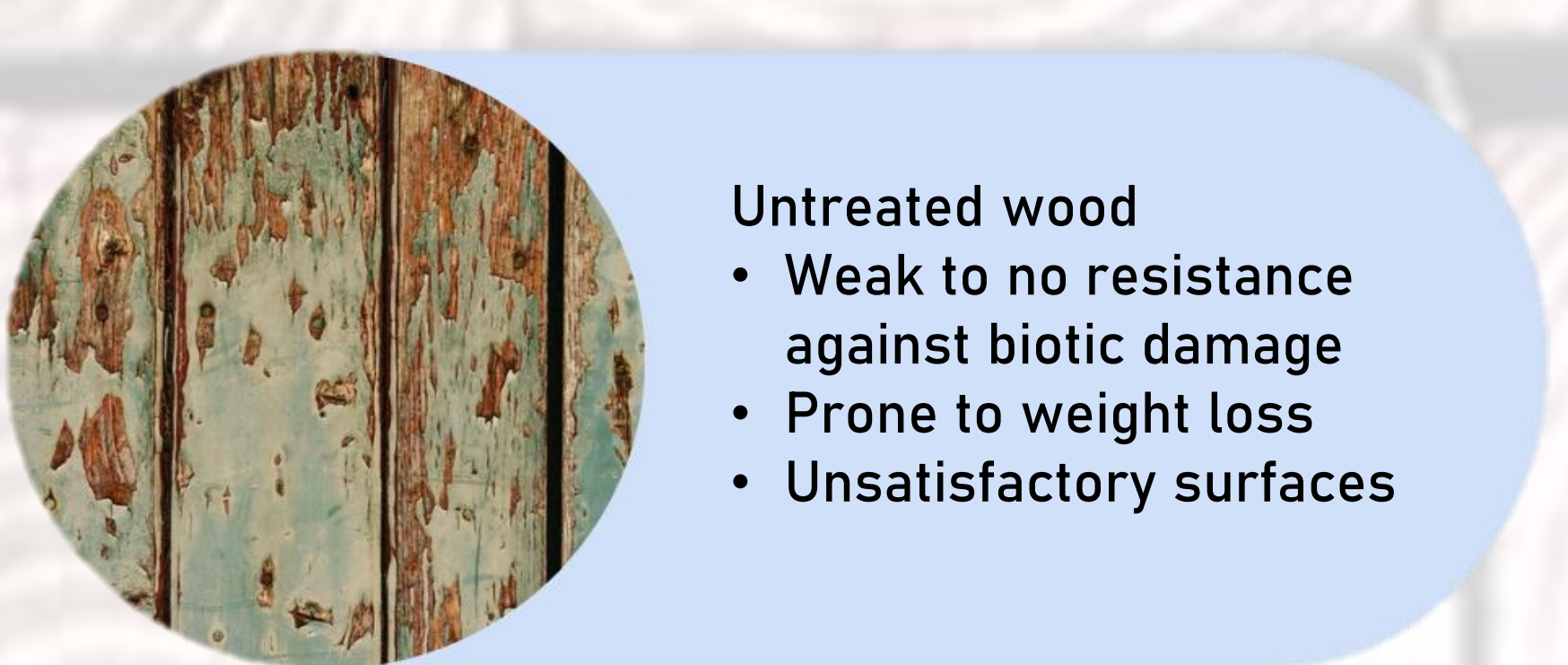


Reforming wood preservative delivery approaches: employment of nanoparticles and self-emulsifying drug delivery systems

Introduction

Wood has been a long-running resource exploited by humans but is susceptible to damage from fungi and pests, affecting its shelf life. Preservation techniques have since been invented to protect wood from deterioration. Two potential approaches may enhance current preservation techniques, namely nanoparticles and self-emulsifying drug delivery systems to transport biocides. This poster will provide an overview of how the two approaches will reimagine our current understanding of creating a more sustainable, environmentally friendly wood preservation approach.



- ### Advantages
- Lesser mammalian toxicity
 - Lesser ecotoxicity towards environment
 - Better penetration and retention in wood
 - Degradable by chemical or biological means
 - Cheaper cost

Problem Statement

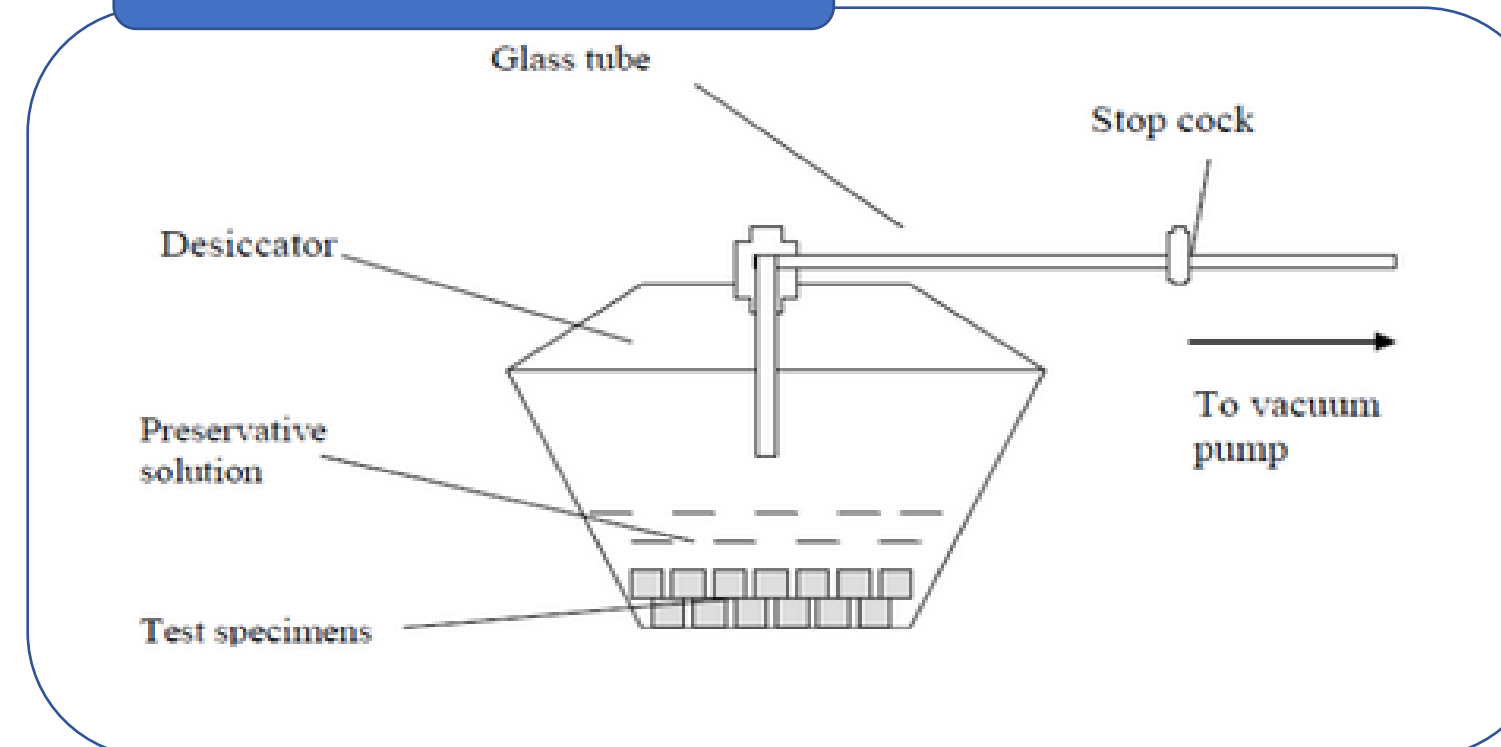


Figure 1. Vacuum pressure treatment [1]

- Water-based pressure treatment is the current industry standard
- Organic preservatives have poor water solubility
- Resulting in low preservative delivery and poor retention in the treated wood

Approach 1: Nanoparticles

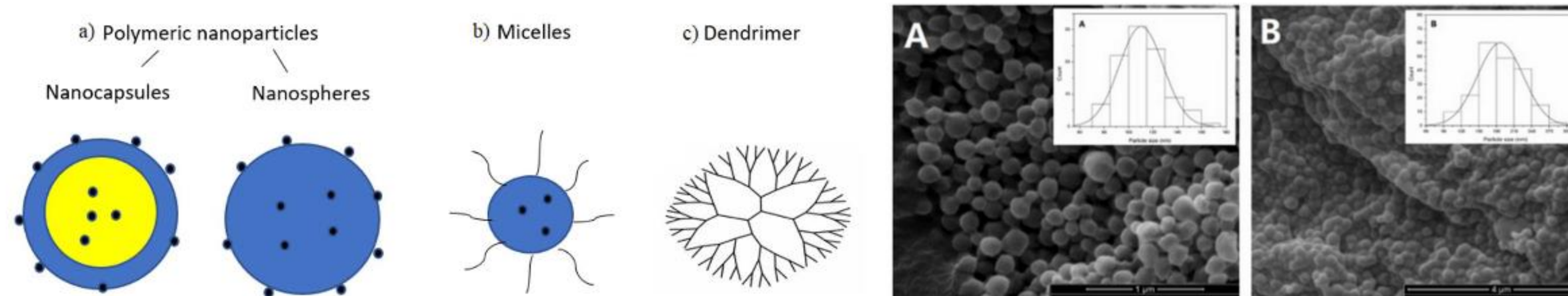


Figure 2. types of nanoparticles [1]

- Nanoparticles act as carriers to transport hydrophobic biocides (chlorothalonil, tebuconazole) via encapsulation
- Can be achieved through nanoprecipitation, emulsion-diffusion or double emulsification
- Nanoparticles types include polymeric, micelles, and dendrimers
- Materials include polylactic acid, polyvinylpyridine, chitosan

Approach 2: Self-Emulsifying Drug Delivery System

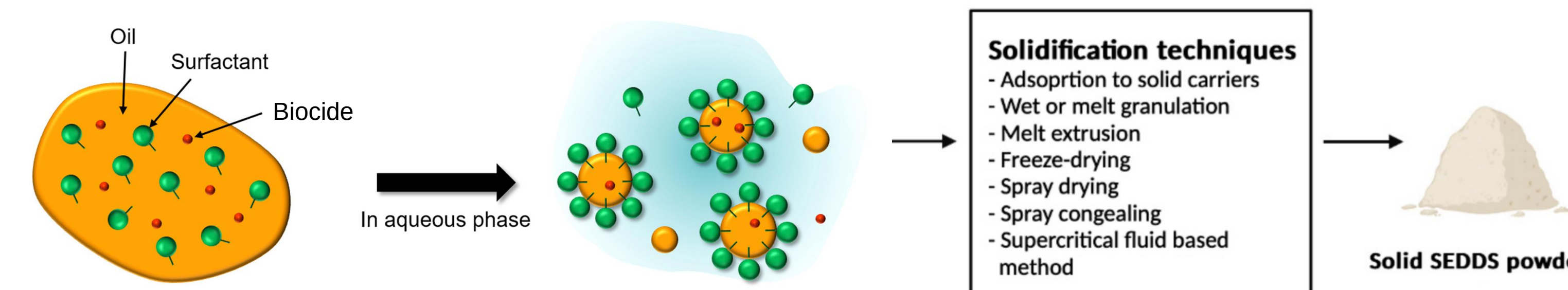


Figure 4. schematic diagram of SEDDS synthesis and conversion to solid SEDDS [2] [3]

- An isotropic mixture of an oil and surfactant that encapsulates the hydrophobic biocide
- Forms microemulsion when mixed with water, forming micro- or nano-emulsions
- Viable oils include synthetic (Capryol 90, Captex 355) or natural oils (palm oil, corn oil)
- Can be administered in powder form, pellets, capsules, or dry emulsions for storage

Benefits & Potentials

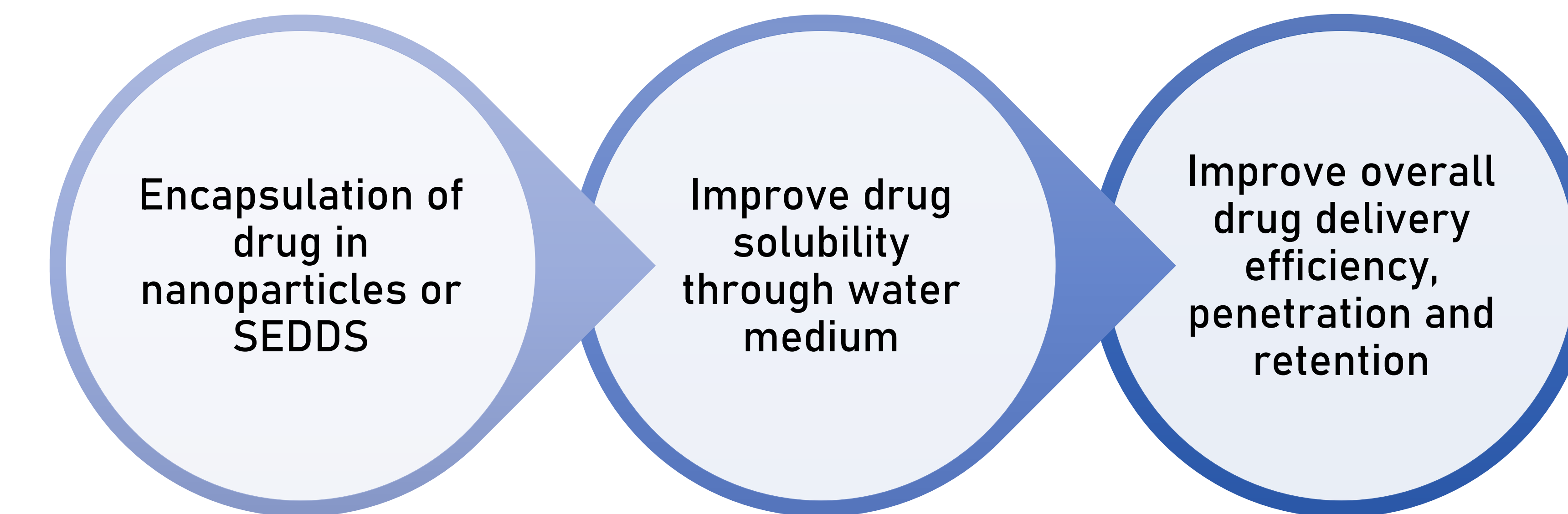


Table 7.3 Effectiveness of treatment for wood samples treated with CTL-PLA nanoparticles and CTL-PLA-PEG nanoparticles

Sample	Treatability, L m ⁻³		Chemical retention, kg m ⁻³	
	Standard	Reduced	Standard	Reduced
Wood treated with CTL-PLA nanoparticles	338.0 ± 3.00	322.7 ± 9.29 (100 PSI and 60 min)	8.45 ± 0.075	8.07 ± 0.232 (100 PSI and 60 min)
Wood treated with CTL-PLA-PEG nanoparticles	348.8 ± 6.33	342.3 ± 3.36 (100 PSI and 120 min)	8.66 ± 0.136	8.51 ± 0.083 (200 PSI and 60 min)

*Standard condition (200 PSI and 120 min).

Figure 5. Comparison of treatment for wood samples treated with CTL-PLA nanoparticles and CTL-PLA-PEG nanoparticles[1]

Teng et al. (2018) [1] demonstrated poly(lactic acid)-poly(ethylene glycol) nanoparticles can incorporate chlorothalonil, and that it adsorbs effectively into rubberwood at a lower energy input than the current industry standard, improving cost, time and efficiency.

Conclusion

Organic biocides are the new generation of preservatives that offer good performance while posing lesser harm to humans and the environment. As they are generally poorly soluble in water, industry-standard water pressure treatments may not fully release their potential. To overcome this obstacle, we can look at approaches such as nanoparticles and self-emulsifying drug delivery systems (SEDDS) to improve delivery efficiency, penetration and retention in the wood. As more materials are discovered and researched, we can improve current approaches and optimize the wood preserving industry.

References

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