Encapsulated biocides

21st of November 2017, Danske Maritime

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Background

- Biocide release from state-of-art hull coatings is initially high
- Lowering the release initially could save biocide
- Environmental profile of the product
- Cost
- Performance

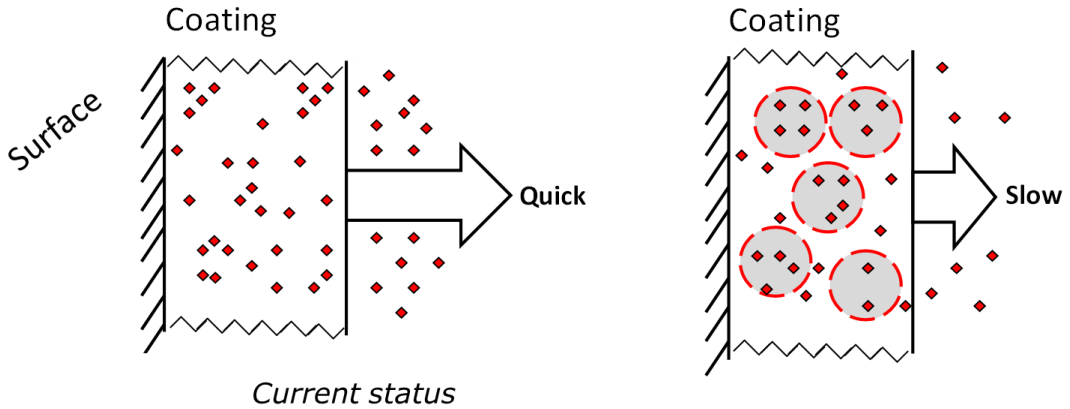
Project goal

Long-term aim: control the leach rate of biocides from coating

- Increased longitivity of coating
- Keep high performance of silicone coating
- Reduced environmental impact
- Utilise other/new biocides

Project goal

- Is encapsulation a viable technique to obtain controlled release of biocides in hull coatings?



Framework

- Consortium: Hempel and DTI
- 2½ years project period
- Total budget: 2.0 mio. DKK

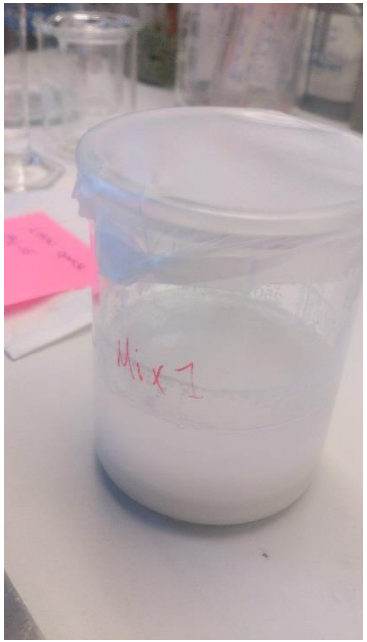
Project review – first approach

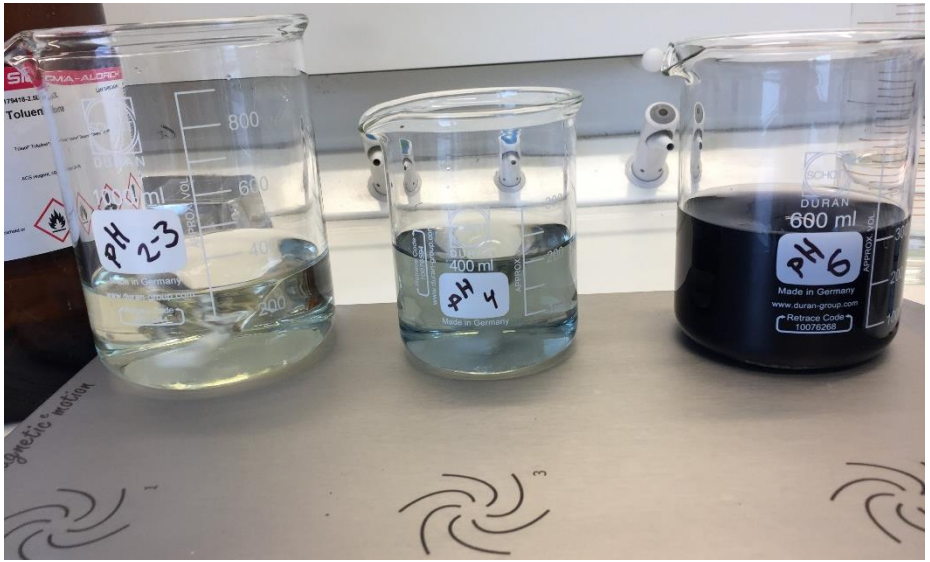
Encapsulation by silica

- Successful synthesis and upscaling
- In-depths characterization (SEM, Raman/FTIR, ICP-MS, AAS) to confirm encapsulation
- Incorporation of capsules in hull coating
- Release: Limited effect

- Varying encapsulation parameters: curing time, surfactants, shell thickness
- Characterization: SEM, morfologi, Raman/FTIR, XRF
- Incorporation of capsules in hull coating
- Release: No effect (based on many samples)

Synthesis

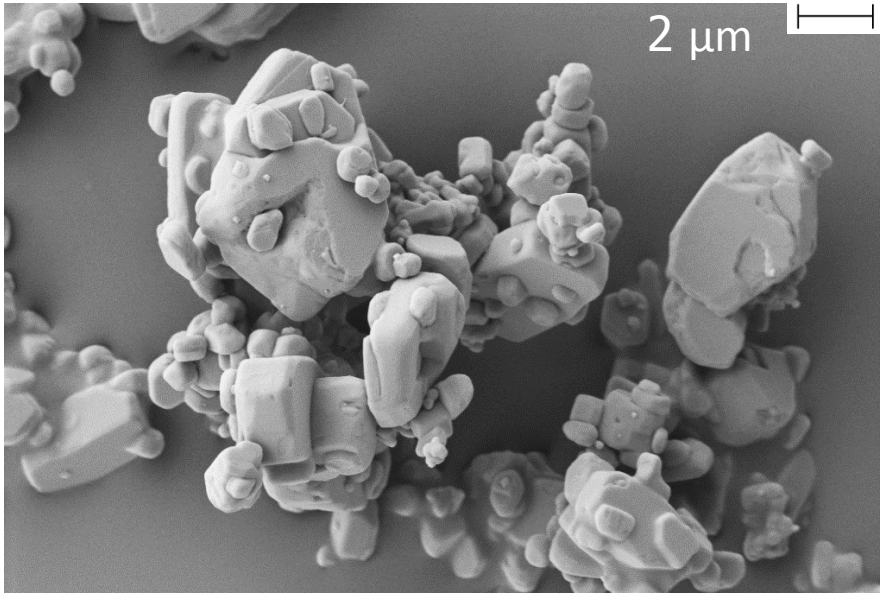

Mix 1


pH 2-3
400 ml
pH 4
660 ml
pH 6
Made in Germany
www.duran-group.com
Retrace Code
10076268

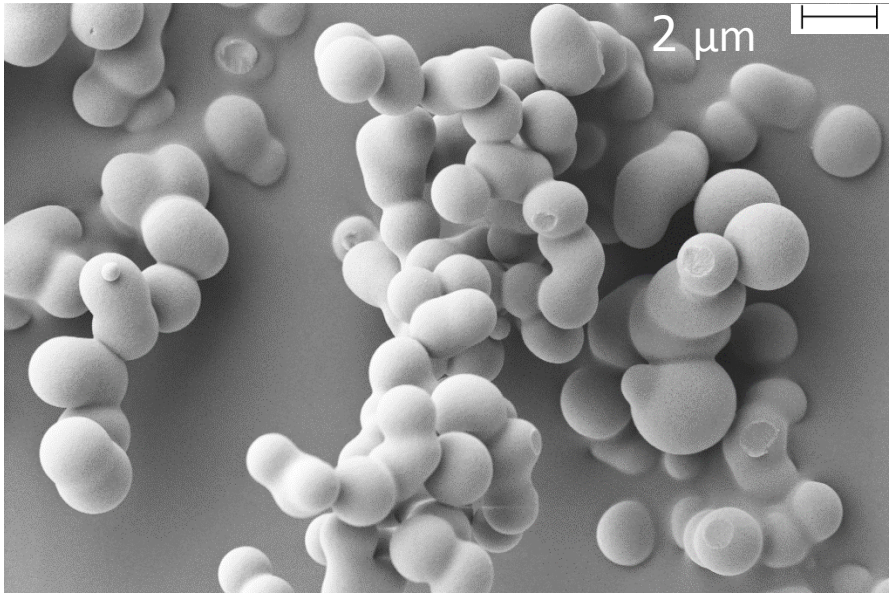
Characterization

Scanning Electron Microscope

Neat biocide, Zn-Pt



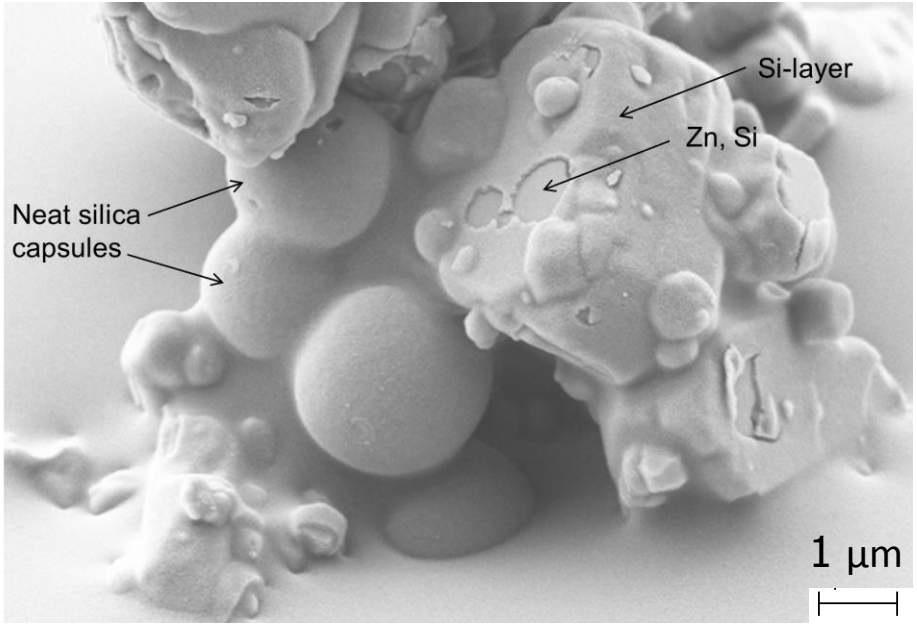
Neat silica capsules



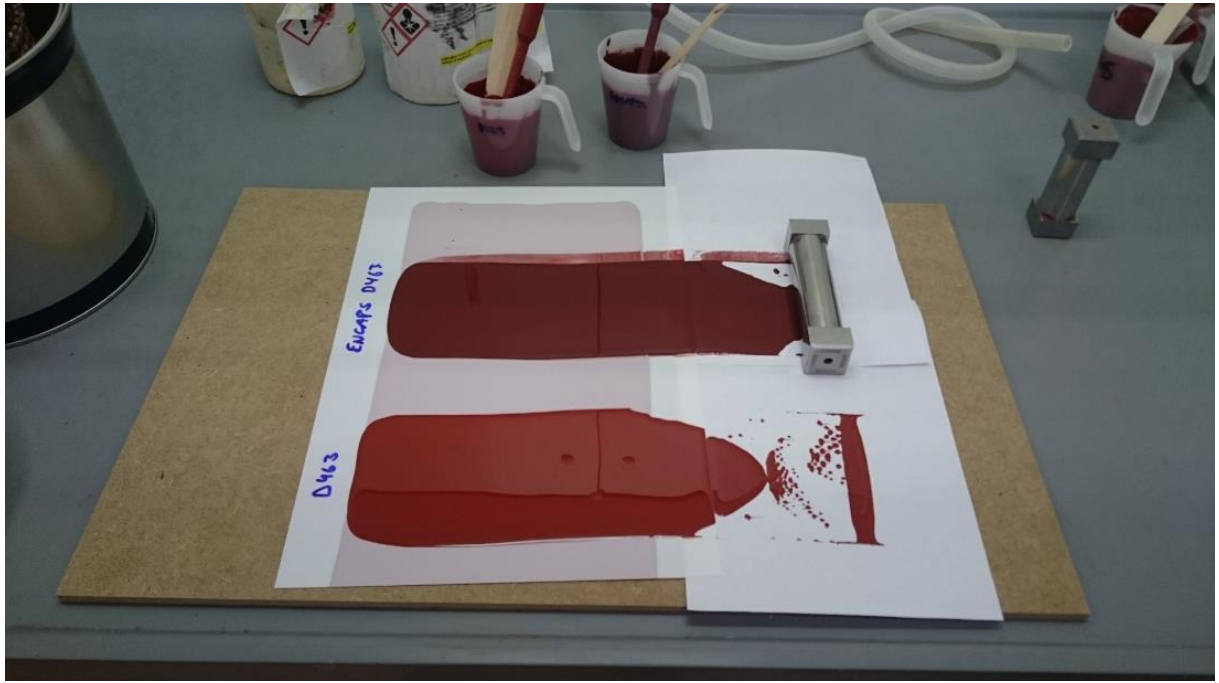
Characterization

Scanning Electron Microscope

Encapsulated biocide



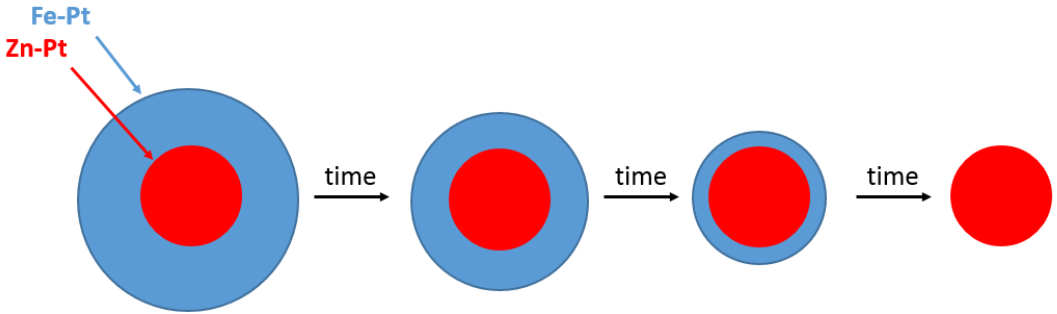
Incorporation in hull coating



Second approach

Encapsulation of Zn-Pt by other (less soluble) M-Pt

- Target: Close capsules
- Successful synthesis – cannot be controlled



Third approach

Encapsulation of Zn-Pt by iron and tannic acid

- Target: Close capsules
- Target: Learn about ‘hot’ chemistry

- Partly successful synthesis – challenging to characterize
- Release: No/limited effect

Potential spin off …

- Alternative pyrithione-based biocide

Scientific conclusion

- Gained knowledge and experiences with 3 different encapsulation approaches
- Did not achieve the desired release

- Conclusion: Encapsulation is not a technical viable solution

Value creation

- Scientific basis to conclude to discontinue investments in encapsulation of biocides in silicone coatings
  - Release of ressources at Hempel

- Side discovery: An alternative good biocide
  - Is being further investigated at Hempel

Future added value

- Strong collaboration between Hempel and DTI
  - Initiated a new joint R&D project supported by the Danish EPA
- Contribution to the discovery of the value in minimal viable product
  - The mindset is being implemented at Hempel
- Increased knowledge and experience about encapsulation
  - DTI can apply this in other contexts

Feedback to BlueINNOship

- Many R&D funded projects require that the developed technologies end in a product. We acknowledge that it has been possible to perform technology screening.

- Blue INNOship has allowed pragmatic project management and allowed us to change approach, i.e. optimum use of resources.

Conclusion: Hempel has got courage to participate in similar joint projects.