NIR spectroscopy at the shipyard

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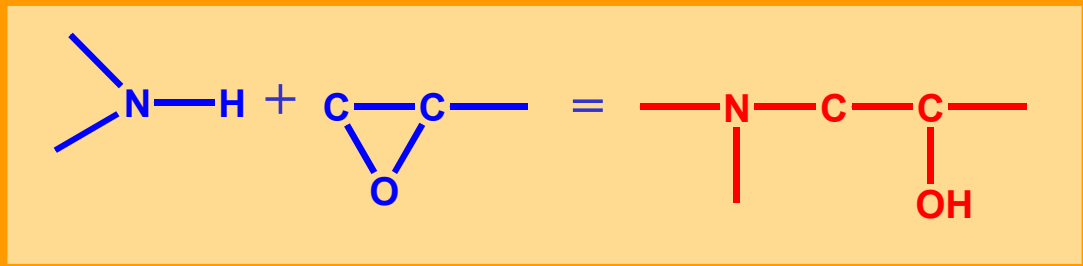
Corrosion in double hull ballast tanks is a factor of potential safety and financial risk (*Liu*, ABS seminars 2001).

Ballast tank insides represent ca. 70% of the total coated area of the ship. Premature failure & recoating would cost ca. 20% of the total building cost

➡ Outmost care on coatings selection, formulation and application

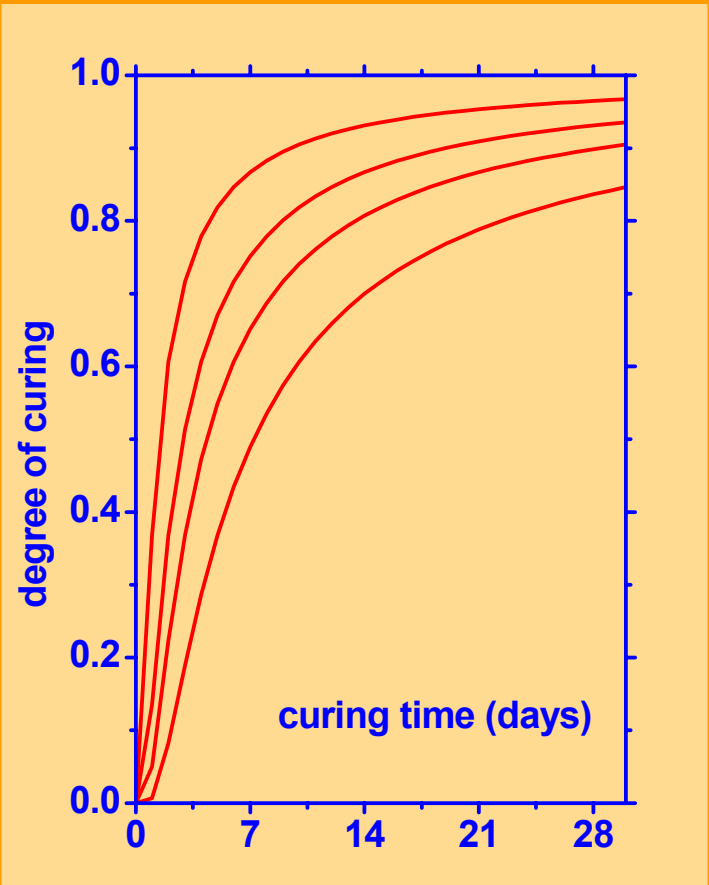
Lack of data: Need for R&D and novel QC procedures

Two component epoxy - amine (or amine/amide) paint systems are chosen on the basis of their chemical & mechanical resistance in marine environments.



Paints are complicated multicomponent systems.

Can we confirm identity between two lots?



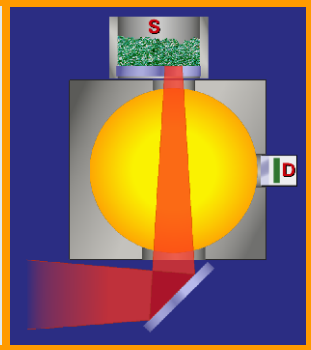
Coating stays “alive” for several weeks!

Identification is useful in the early stages of curing, but should not be biased by differences in the degree of curing

Near-Infrared spectroscopy

❶ Provides information on molecular structure of organic materials. No metals!

Ø 4mm

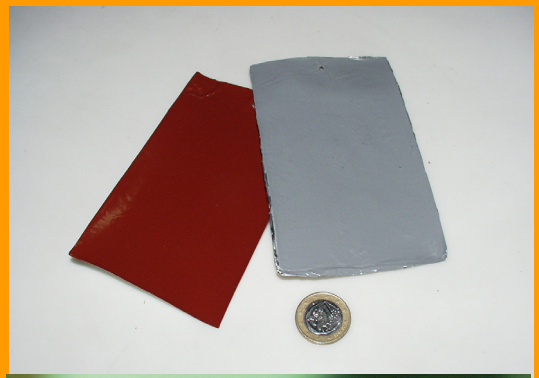


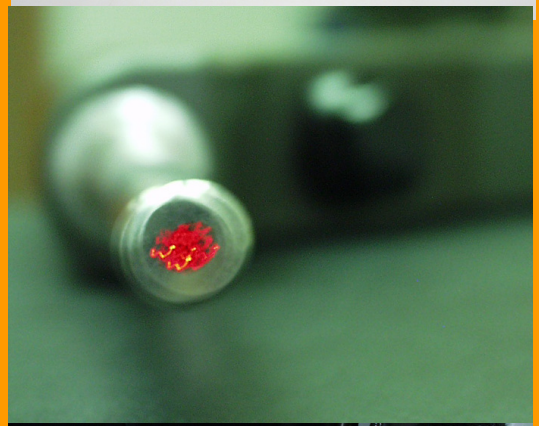
Ø 2cm

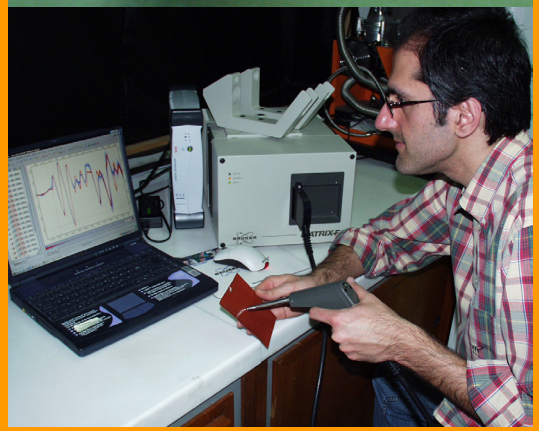
Ø 10-20cm

❷ fast, non-destructive, highly reproducible data collection

❸ large spectral databases can be acquired



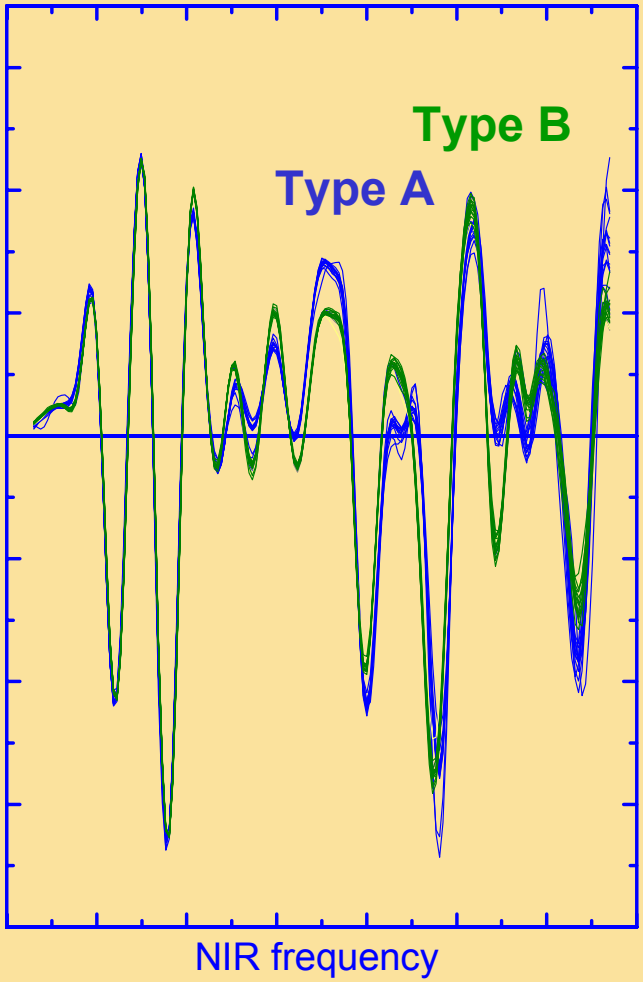




At the shipyard:

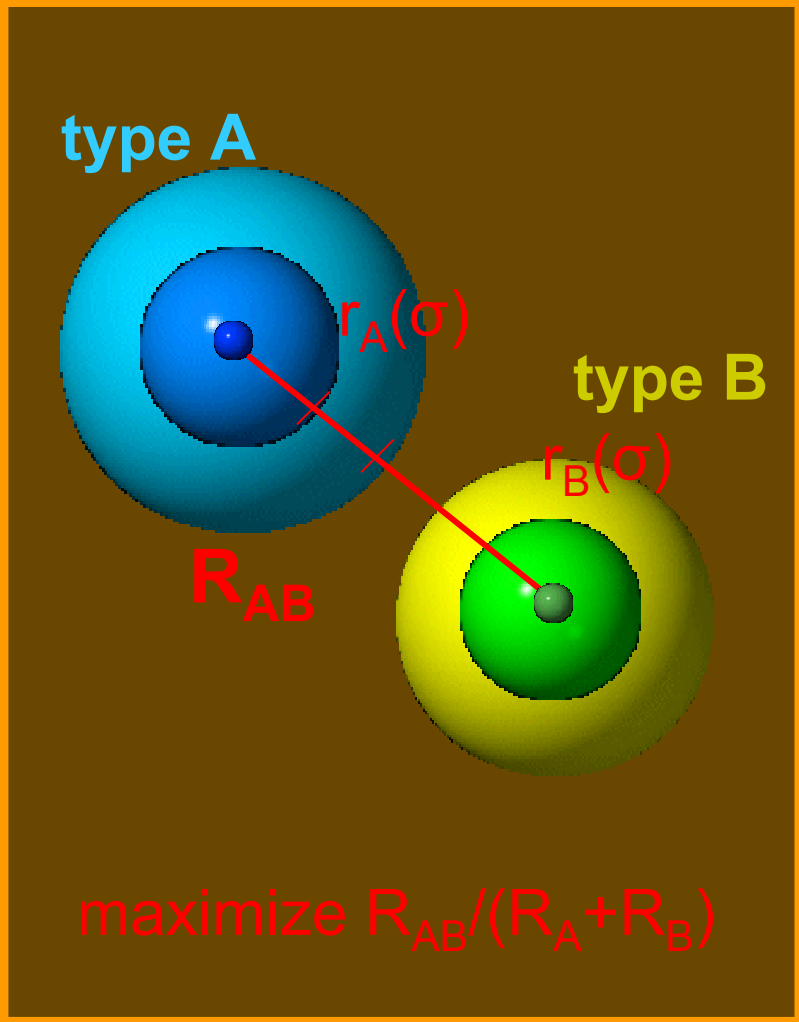
A. Coating samples are collected on aluminum panels and left to dry/cure overnight.

B. The operator directs a NIR beam via an optical fiber bundle probe to the coating and collects the reflected spectrum (absorption vs. frequency). Data collection takes 20 seconds / spot.

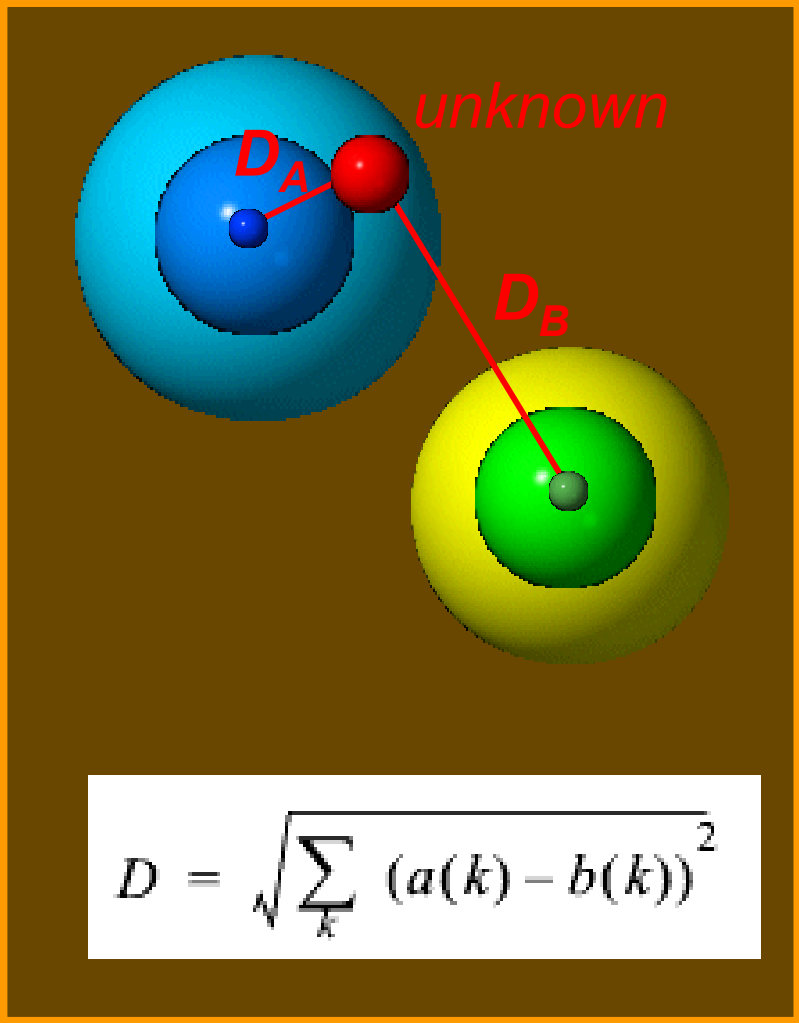


C. The spectra are mathematically treated to remove unwanted information (e.g curing dependent) and to maximize the signature from the starting components (nature and proportion).

These data treatment parameters constitute the conformity (identity) criterion.



D. The statistics of the spectra for each type of coatings are calculated. These statistical parameters (mean, σ, confidence levels) constitute the identification algorithm, which is updated (revalidated by the leave-one-out-method) frequently as the size of the sample database increases.



E. When the spectrum of an unknown coating is obtained, it is compared in real time to the pre-defined spectral distributions of the various coating types. A conformity report is created by comparing D_i to $R_i(\sigma)$.

The whole procedure (acquisition + analysis) takes less than 30 sec.

take sample

dry/cure

calibrate

validate

NHRF

measure

store

analyze

Not OK

NHRF or shipyard

OK