Considering the concepts of synergism and adsorption isotherms in corrosion inhibition

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The concepts of synergism and adsorption isotherms are often utilized in corrosion inhibition studies. However, the theoretical foundations underlying these concepts are not always well understood, and consequently, various pitfalls are committed sometimes.

Synergism is often quantified with the synergistic parameter. This parameter has only been applied to binary inhibitor mixtures in the literature until recently. In the corresponding equation, the mixture's inhibition efficiency is evaluated against a threshold inhibition efficiency based on the performance of pure compounds, and the threshold of Aramaki–Hackerman [1] is usually used. However, the author recently showed that the choice for the threshold value is not unique, proposed several other reasonable choices, and extended the corresponding synergistic models to multi-component mixtures [2].

In corrosion inhibition studies, the standard adsorption Gibbs energy is often estimated via the linear regression of the Langmuir isotherm in the $c/\vartheta = 1/K + c$ form (c = inhibitor concentration, ϑ = fractional surface coverage, K = adsorption equilibrium constant), where both the intercept and the slope are estimated, although the Langmuir isotherm requires the slope of 1. Hence, $c/\vartheta = 1/K + mc$ is used instead, where m is the slope. A theoretical basis for this equation was recently established [3], and a new general-purpose Type–I adsorption isotherm was proposed [4] based on considering a functional dependence of various adsorption models on the c/ϑ vs c plot. This new isotherm is flexible enough to describe various adsorption scenarios and provide relatively accurate estimates of the standard adsorption Gibbs energy, provided surface coverages are reliably determined experimentally [4,5]. Among the various adsorption models that the new isotherm can describe are those that consider lateral inter-adsorbate interactions, molecular size, surface heterogeneity, and mobile adsorption.

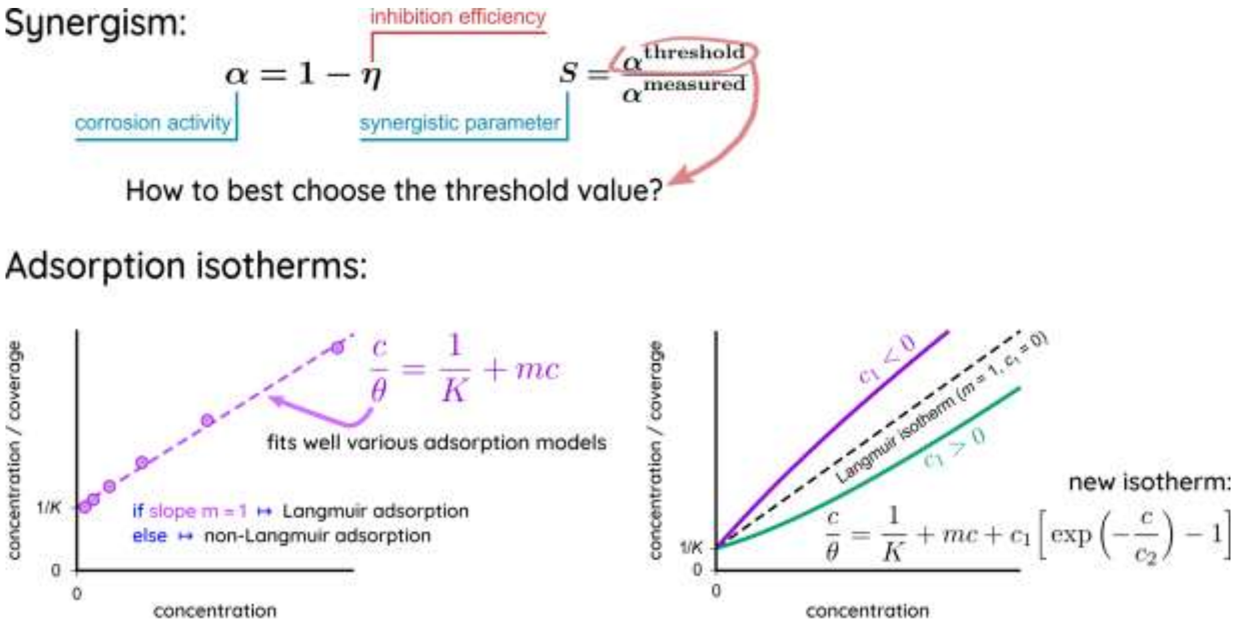

Figure 1. The equation for the synergistic parameter can be easily extended to multi-component mixtures if corrosion activity is used instead of corrosion efficiency (top). Based on the analysis of functional dependence of various adsorption models on the c/ϑ vs c plot (bottom left) a new general-purpose Type-I adsorption isotherm was proposed (bottom right).

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References

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