EXPIRED DRUGS AS GREEN CORROSION INHIBITORS FOR INDUSTRIAL APPLICATIONS

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Background

- Corrosion of metals and their alloys during the **pickling process** is one of the problems that industries faces today.
- The focus of recent research activities was oriented towards the **developing green alternatives** to the synthetic corrosion inhibitors (CI) currently used.
- **Expired drugs** have been proven to be effective as corrosion inhibitors and considered green alternatives due to being **biotolerable, nonbioaccumulative and biodegradable**.
- The current approach to dealing with expired medications is incineration, however repurposing them for industrial uses could be a successful **recycling strategy**.
- **Tantum Rosa** (benzydiamine hydrochloride) has been tested as a CI for **mild steel** in strong acidic media, hydrochloric acid (HCl).

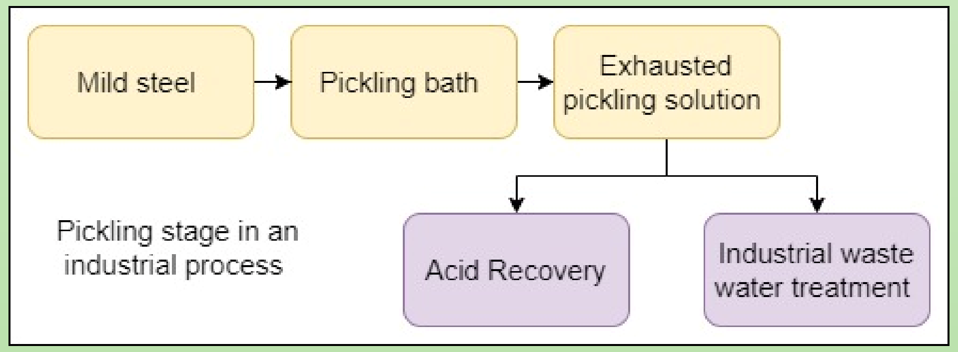

Figure 1. Industrial pickling stage

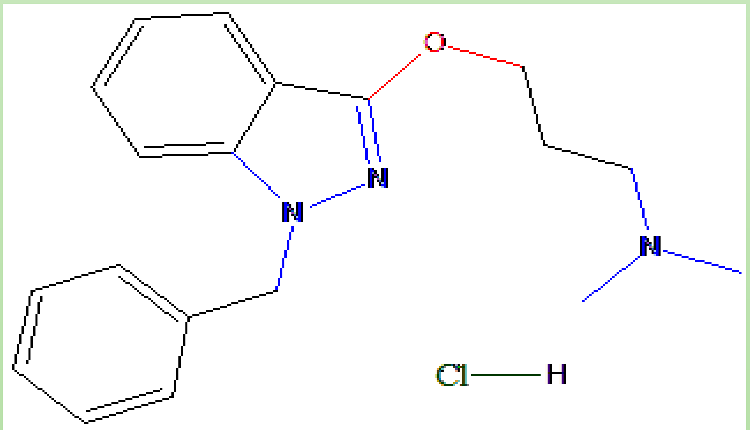

Figure 2. Molecular structure of benzydiamine hydrochloride

Methodology

Electrochemical impedance spectra (EIS) – recorded at OCP with the frequency rage from 10 kHz to 10 mHz at 5 points per decade, AC amplitude ± 10 mV

Potentiodynamic polarization curves – sweep rate 10 mv min with a potential range of ±500 mV vs OCP

Conclusions

- **Tantum rosa can inhibit the corrosion of mild steel in strong hydrochloric acid solution, as a green corrosion inhibitor**
- **Adsorption of TR drug on mild steel follows the Langmuir adsorption isotherm.**
- **Two modes of interaction, i.e., physisorption and chemisorption can be used to explain the adsorptive behavior of TR drug on mild steel surface.**
- **Industrial applications i.e., pickling have the potential to be an efficient way to recycle/repurpose expired drugs.**

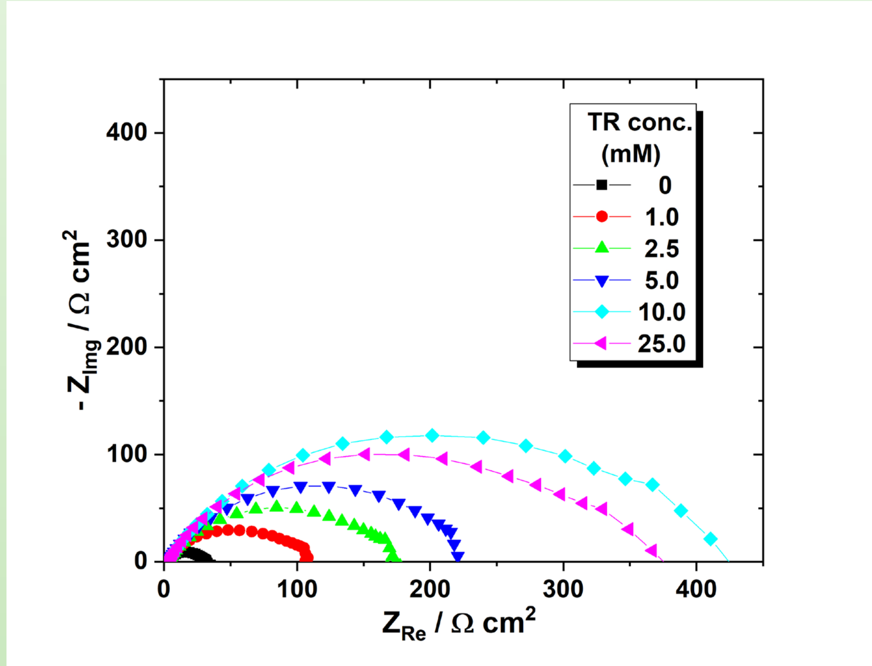

Figure 3. Nyquist diagrams recorded after 15 minutes immersion of mild steel in HCl solution without and with different concentrations of Tantum Rosa drug at 298 K

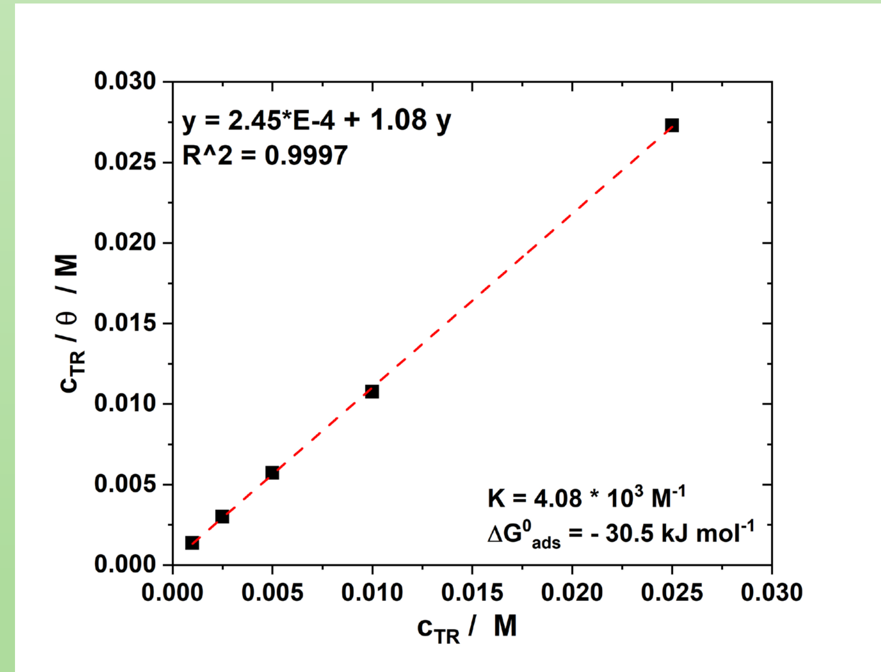

Figure 4. Langmuir adsorption isotherm for mild steel in HCl solution containing *Tantum Rosa* drug

Results & Discussions

Table 1. Impedance parameters for mild steel corrosion in the absence and in the presence of Tantum Rosa drug at different concentrations

TR (mM)	R_s (Ω cm²)	R_p (Ω cm2)	CPE (μF s^{n-1} cm^{-2})	n	C_{dl} (μFcm^{-2})	IE (%)
0	3.17	28.01	673.5	0.773	209.9	-
1	2.99	103.1	547.3	0.712	171.1	72.8
2.5	2.97	168.0	466.0	0.707	162.1	83.3
5	3.11	223.4	414.3	0.701	150.1	87.5
10	3.16	399.4	308.3	0.700	128.3	93.0
25	3.20	333.5	367.5	0.718	161.1	91.6

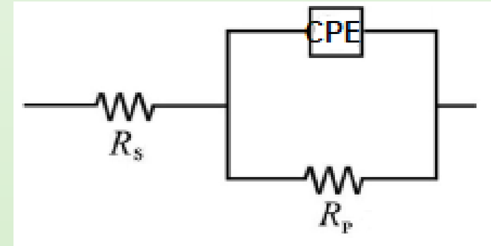

Figure 5 Equivalent electrical circuit model used to fit the EIS experimental

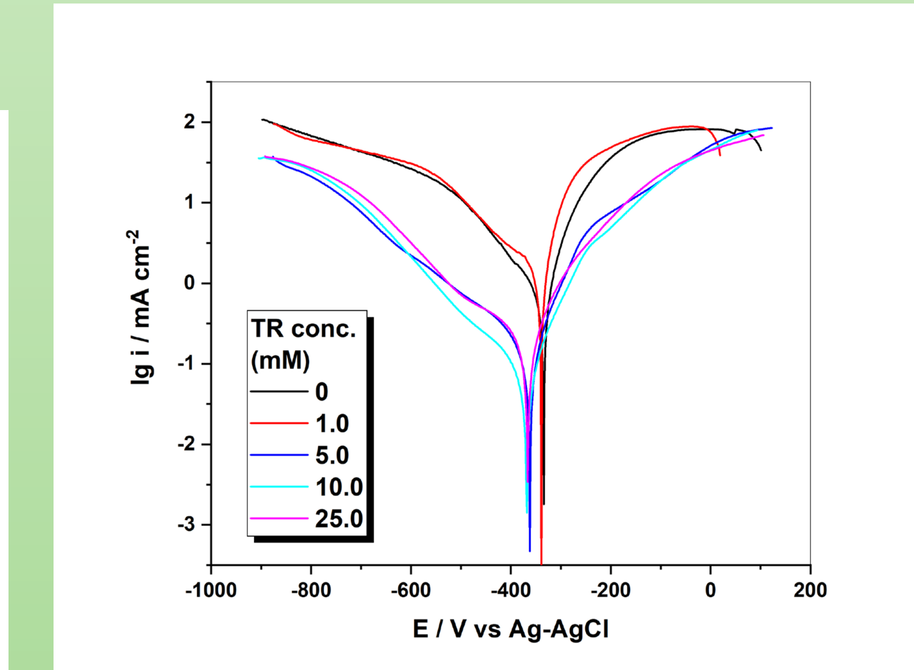

Figure 5. Potentiodynamic polarization curves mild steel in concentrated HCl solution in the absence and in the presence of different concentrations of Tantum rosa drug

Table 2. Electrochemical parameter of mild steel in concentrated HCl in the absence and in the presence of various concentrations of TR drug determined by the Tafel method

TR (mM)	E_{corr} (mV vs. Ag-AgCl)	i_{corr} (mA/cm²)	$\lvert\beta_C\rvert$ (mV/dec)	β_a (mV/dec)	IE (%)
0	-333.51	7.43	476	218	-
1	-339.1	1.97	253.8	88.7	73.49.
5	-361.8	1.09	341.4	212.55	85.33
10	-367.08	0.08	162.6	76.8	98.9
25	-367.89	0.16	173.1	76.6	97.84