Contents

Preface ---- V

List of contributors --- XI

Muhammad Abubaker Khan, Zahid Nazir, Muhammad Hamza, Mohammad Tabish, Ghulam Yasin

| Τ. | All introduction to natural corresion inhibitor — 1 |
|-------|--|
| 1.1 | Introduction —— 1 |
| 1.2 | Natural corrosion inhibitors —— 3 |
| 1.3 | Plants extract as a natural corrosion inhibitor —— 4 |
| 1.3.1 | Extraction process —— 4 |
| 1.3.2 | Fruits as natural corrosion inhibitors — 6 |
| 1.3.3 | Oils as a natural corrosion inhibitor —— 6 |
| 1.4 | Absorption mechanism of natural corrosion inhibitors — 7 |
| 1.5 | Factors influencing the efficiency of CIs —— 10 |
| 1.5.1 | Measuring GCIs efficiency —— 11 |
| 1.6 | Industrial applications of GCIs —— 12 |
| 1.7 | Conclusion —— 12 |
| | References —— 12 |

Humira Assad, Abhinay Thakur, Ayan Bharmal, Shveta Sharma, Richika Ganjoo, Savas Kaya

2 Corrosion inhibitors: fundamental concepts and selection metrics — 19

| 2.1 | Introduction —— 19 |
|-------|--|
| 2.2 | Chemistry and adverse impact of corrosion —— 21 |
| 2.3 | Corrosion inhibitors —— 22 |
| 2.4 | Classification of corrosion inhibitors — 24 |
| 2.4.1 | Based on electrode process —— 25 |
| 2.4.2 | Based on environment —— 29 |
| 2.4.3 | Based on mode of protection —— 32 |
| 2.5 | Mechanism of corrosion inhibition — 36 |
| 2.5.1 | Inhibitors for acidic environments —— 36 |
| 2.5.2 | Corrosion inhibitors for oil/gas production and transport — 37 |
| 2.5.3 | Inhibitors in near-neutral solution —— 38 |
| 2.5.4 | Gaseous and atmospheric corrosion — 39 |
| 2.6 | Application of corrosion inhibitors — 40 |
| 2.6.1 | In cooling waters —— 41 |
| 2.6.2 | in concrete —— 41 |
| 2.6.3 | Acid pickling and boilers —— 42 |

| 2.6.4 | Oil industry —— 42 |
|-----------|--|
| 2.6.5 | Electronic industry —— 42 |
| 2.7 | Patents in the field of corrosion inhibitors —— 43 |
| 2.8 | Conclusion — 44 |
| | References —— 45 |
| | |
| Omar Dago | dag, Rajesh Haldhar, Seong-Cheol Kim, Elyor Berdimurodov, |
| | nso, Savaş Kaya |
| 3 Na | tural corrosion inhibitors: adsorption mechanism 51 |
| 3.1 | Introduction —— 51 |
| 3.2 | The inhibition mechanism of the plant extract —— 54 |
| 3.2.1 | Weight loss measurement —— 54 |
| 3.2.2 | Potentiodynamic polarization —— 56 |
| 3.3 | Chemical analysis —— 57 |
| 3.4 | Surface analysis —— 57 |
| 3.5 | Conclusions — 58 |
| | References —— 58 |
| | |
| | ingh, Kashif Rahmani Ansari, Shivani Singh, |
| | hmed Quraishi |
| | ants as corrosion inhibitors for metals in corrosive media —— 61 |
| 4.1 | Introduction —— 61 |
| 4.2 | Carbon steel corrosion inhibitors — 62 |
| 4.3 | Studies involving temperature and time interval — 64 |
| 4.4 | Mechanism of adsorption and quantum chemical |
| | characterization —— 66 |
| 4.5 | Corrosion inhibitors for other metals —— 68 |
| 4.6 | Conclusion — 69 |
| | References — 69 |
| | |
| | Sanni, Jianwei Ren, Tien-Chien Jen |
| | omass waste as corrosion inhibitor for metals in corrosive |
| | edia —— 75 |
| 5.1 | Introduction —— 75 |
| 5.2 | Corrosion inhibitors — 78 |
| 5.3 | Biomass wastes —— 80 |
| 5.3.1 | Biomass wastes extract as corrosion inhibitors —— 82 |
| 5.3.2 | Mechanism of inhibition —— 85 |
| 5.3.3 | Future scope —— 87 |
| 5.4 | Conclusion —— 87 |
| | References —— 88 |
| | |

| Younes | Ahmadi, Mubasher Furmuly, Nasrin Raji Popalzai |
|---------|--|
| 6 | Biopolymers as corrosion inhibitors for metals in corrosive |
| | media —— 97 |
| 6.1 | Introduction —— 97 |
| 6.2 | Anticorrosive biopolymer-based composite and nanocomposite |
| | coatings — 98 |
| 6.2.1 | Chitosan-based anticorrosive coatings —— 99 |
| 6.2.2 | Cellulose-based anticorrosive agents —— 103 |
| 6.2.3 | Other biopolymer-based anticorrosive materials —— 105 |
| 6.3 | Anticorrosive mechanism of biopolymer-based materials —— 107 |
| 6.4 | Conclusion —— 108 |
| | References —— 109 |
| Elyor B | erdimurodov, Abduvali Kholikov, Khamdam Akbarov, Khasan |
| Berdim | uradov, Omar Dagdag, Rajesh Haldhar, Mohamed Rbaa, |
| Dakesh | war Kumar Verma, Lei Guo |
| 7 | Modern testing and analyzing techniques in corrosion —— 115 |
| 7.1 | Introduction —— 115 |
| 7.1.1 | Analysis in corrosion —— 115 |
| 7.2 | Main part —— 116 |
| 7.2.1 | Electrochemical testing in corrosion —— 116 |
| 7.2.2 | Surface analysis in corrosion —— 123 |
| 7.2.3 | Theoretical analysis in corrosion —— 127 |
| 7.3 | Conclusion —— 133 |
| | References —— 133 |
| Rajimo | l Puthenpurackal Ravi, Sarah Bill Ulaeto, Thazhavilai Ponnu |
| Deva R | ajan, Kokkuvayil Vasu Radhakrishnan |
| 8 | Natural product-based multifunctional corrosion inhibitors for smart |
| | coatings —— 139 |
| 8.1 | Introduction —— 140 |
| 8.1.1 | Natural product-based corrosion inhibitors —— 140 |
| 8.2 | Smart coatings —— 143 |
| 8.2.1 | Properties of natural products beneficial for smart coatings —— 144 |
| 8.3 | Natural product-based smart coatings —— 144 |
| 8.3.1 | Anticorrosion coatings —— 144 |
| 8.3.2 | Self-healing coatings —— 147 |
| 8.3.3 | Self-cleaning coatings —— 152 |
| 8.3.4 | Antifouling coatings —— 154 |
| 8.3.5 | Antimicrobial coatings —— 159 |
| 8.3.6 | Fire-retardant coatings — 160 |
| 8.3.7 | Anti-graffiti coatings —— 162 |

| 8.3.8 | Antismudge coatings —— 162 |
|---------|---|
| 8.3.9 | Anti-icing coating —— 163 |
| 8.4 | Corrosion inhibition mechanism of natural product-based smart |
| | coatings — 164 |
| 8.5 | Applications and commercial viability of bio-based smart |
| | coatings — 167 |
| 8.6 | Future scope —— 168 |
| 8.7 | Conclusion —— 168 |
| | References —— 169 |
| Ruby A | slam, Mohammad Mobin, Jeenat Aslam |
| 9 | Commercialization of environmentally sustainable corrosion |
| | inhibitors — 175 |
| 9.1 | Introduction: corrosion and its impact —— 175 |
| 9.2 | Global corrosion inhibitor market —— 177 |
| 9.2.1 | Marketplace dynamics of corrosion inhibitors —— 178 |
| 9.2.2 | Market of corrosion inhibitors by product —— 180 |
| 9.2.3 | The market of environment-friendly corrosion inhibitors, by |
| | application —— 181 |
| 9.2.4 | Recent patents on corrosion inhibitors —— 183 |
| 9.3 | Impact of COVID-19 pandemic on the global market of corrosion |
| | inhibitor —— 185 |
| 9.4 | Conclusion and future scope —— 185 |
| | References —— 186 |
| Richika | Ganjoo, Shveta Sharma, Humira Assad, Abhinay Thakur, |
| Ashish | Kumar |
| 10 | Challenges and future outlook —— 189 |
| 10.1 | Introduction —— 189 |
| 10.2 | Drawbacks of plant extracts as corrosion inhibitors —— 190 |
| 10.3 | Biomass, agriculture, and biopolymer wastes and essential oils |
| | as green corrosion inhibitors: challenges and prospects —— 196 |
| 10.4 | Limitations of research techniques utilized in corrosion inhibition |
| | investigations —— 199 |
| 10.5 | Conclusion —— 201 |
| | References — 202 |

Index ---- 205