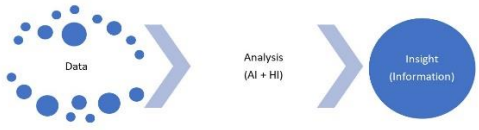
STEM-Corrosion™

2022 August Edition: Newsletter 23

Artificial Intelligence and Human Intelligence



Current buzzwords include artificial intelligence (AI), machine learning (ML), intelligence automation (IA), and deep learning (DL). These buzzwords have also entered into oil and gas industry. Oil and gas industry is in the crossroads on the use of AI. "Young generation" promoting its use whereas "experienced" folks being skeptical about it.

One of the key successes of using AI is our ability to properly train it. For this we need good data. An AI trained with poor data or incomplete database will lead to wrong, and sometimes, dangerous conclusions. The oil and gas industry has a long and rich history and all data from previous years may not be available. Therefore, inputs from experienced subject matter experts (SME) are required to fill the gap in the data and to use those data to properly train AI. Thus, the oil and gas industry, and for that matter any industry, will benefit immensely if AI and human intelligence (HI) are suitably integrated.

The industry extensively depends on API 571, 581, 584, and other standards to establish damage mechanisms (DM) and corrosion rates (CR) of refinery, petrochemical, oilsand, and facility equipment. However, the SME needs to go over (or memorize) 100+ tables, figures, and logics in these standards to establish DM, CR, and risk status. It is humanly impossible to consistently analyze all information and provide consistent results. This is where computer-based intelligence such as "AI" excels.

For example, **STEM_Risk_Refinery™** analyses 100+ materials, 100+ operational conditions, and 100+ DM to provide most appropriate DM, CR and risk status of an equipment or associated pipes. The results are still reviewed and stamped by SME. Such AI and HI integration reduces time, cost, and errors without compromising quality of analysis and without overlooking any key information. Such approach has successfully been implemented in the industry.

Raising Star of This Newsletter:

Chidambaram Subramanian

My Story

I started my career as a Metallurgical Engineer in continuous cast ETP grade copper rod production after B.E. After M.Tech in Fracture Mechanics from IITK, I have worked in TATA Steel production steel melting shop, flat product continuous casting, hot & cold steel rolling. I have gained significant experience in plate production especially for oil and gas industries (pressure vessel and piping). Subsequently i moved to downstream petroleum refinery (Bharat Petroleum) and worked for nearly six years gained rigorous field experience in Corrosion and Inspection of SRU, DCU, CDU/VDU, HGU, HCU, DHDT, CPP and LPG bottling plants. I have solved numerous industrial field problems in oil refinery and improved refinery margin & plant safety.

After that I have moved to largest R&D set up constituted by Govt. of India, CSIR-Central Mechanical Engineering Research Institute. I am currently working as Senior Scientist in Corrosion Science & Engineering, Engineering Failure Analysis, Pressure Vessel and Boilers, Numerical simulation of structural integrity problems from Petroleum Refinery, Welding Engineering, ASME Code Cases, and Engineering Fracture Mechanics applications in refineries. Consultation provided on materials selection using MSD, corrosion control document (CCD), FFS, integrity operating window (IOW) and devise corrosion control plan early during refinery project commissioning.

My Style

I involved in many interdisciplinary engineering field projects and works with various professionals engaged in chemical engineering, process simulation engineering, civil engineering, electrical engineering, chemistry, mathematics, and mechanical engineering. Without sound knowledge on one's own corrosion engineering field and other cross disciplinary field, it is almost impossible to fix any oil industry problems. To be honest, my style of work is deep technical understanding know how with rigorous peer evaluation through international collaboration and systematic field

implementation. Apart, I regularly read corrosion field practice and research articles written by many corrosion experts from NACE (now AMPP) that would logically devise methodology for corrosion problems faced by me.

My day to day activities involved inspection of refinery equipment, identification of damages, and proactive involvement in corrosion control. I have significantly contributed developing repair procedures and fitness for service assessment for various corroded refinery serviced equipment during turnarounds. I have also published many research papers in top corrosion and related engineering journals, which was solved for the employed oil industry and also acting as an international expert reviewer member for corrosion related SCI journals.

Things That Excite Me to Continue in the Industry

Corrosion Engineering and its control in many refineries are challenging. The electrode kinetics and mixed potential calculations in real complex refinery process are extremely difficult and it immense motivates me to continue in Industry. Using API 571, the refinery industry damage mechanisms can be identified, but certainly it alone cannot fix corrosion issues. It thrives me to learn much deep corrosion subject matter continuously. As a practicing corrosion engineer, I also exposed to variety of corrosion problems which excites me to solve critical problems exist in oil and gas industries.

Changes I would Like to Make in the Industry

Energy industry is highly volatile and technology development on decarbonisation, carbon capture, novel electrolysis for production of green hydrogen, Electric Vehicles, Artificial intelligence, data optimization will be explored to reduce green house emission. Recycling of refinery waste water and utilization of fresh water are still posing great challenge to many operators across the world. Fuzzy Logic and AI predicts microbiological induced corrosion on pipeline & crude production upstream sector while similar solutions are not yet addressed till now in downstream refinery sector.

Conventional Alloy development for electrode used in cathodic and anodic protection, repairing of existing static fixed equipment by advanced composite materials, advanced high temperature materials for hydrogen reformer tubes, advanced signals & systems for NDE applications, Probabilistic Risk based Inspection for strategic planning/maintenance and advanced numerical computations may be taken up in next two decades to fix any potential corrosion problems faced by industry.

Advice to Attract Youngsters to the Industry

To be successful in Oil and Gas Industry one must keep expand their technical knowledge both theoretical and practical field experiences even after certifications. The boundary of Corrosion Science and Engineering is keep pushing in almost every sphere of oil and gas/energy industry. Collaboration with international acknowledged corrosion experts will always keep motivating youngsters to solve their local oil industry corrosion problems. Effective communication within team and

research/industry collaboration along with mentoring by corrosion experts can open up the ways to solve many chronic corrosion problems, which is worth saving billion dollars that attract and retain corrosion talents.

Flow induced corrosion, metal dusting, high temperature corrosion, reactor effluent air fin cooler metallurgy, water injection issues, overhead tower top corrosion monitoring and burst pressure models are some interesting corrosion engineering fields still need to be addressed will also attract youngsters especially from Research/Academia collaboration with industries.