Managing materials and inspections across 24 countries...
Dr. Lars Rose of DuPont
Dr. Lars Rose leads the Tests & Inspections program together with a Dutch level III inspector and is Manager of the Materials Program at all DuPont facilities in Europe, the Middle East, and Africa (EMEA) within the framework of the MIQA (Mechanical Integrity and Quality Assurance) program. This is an international team of world class engineers with specialists for welding and piping covering the region from Luxembourg, and dedicated engineers for regional support situated in Ireland, the Netherlands, and Germany, all led by a team lead in Spain. Being on the road “up to four weeks per month” means thinking on his feet and finding solutions for the large number of sites he visits every year. It’s a challenging job for this Doctor of Materials Engineering, but one which he relishes, as he explained to Stainless Steel World recently.

By Joanne McIntyre

“My main responsibility is leading the Materials Program, and improving the tests, inspections, and welding with two other experts” explains Lars. “I travel between 3 and 4 weeks per month, visiting DuPont sites to follow up the programs that are running, assess progress, and provide assistance for any questions or problems. We have a very specific inspection program and I assist our teams in dealing with tests, government regulations and anything related to planned maintenance. An external contractor updates us on regulatory changes as it’s not possible for an individual to know all minutiae of regulations for 24 countries.”

Lars is part of DuPont Engineering Technology, a large group of global experts that develops marketable research ideas into full-scale products and technologies. With world-class skills, personnel, resources and equipment, DuPont Engineering Technology ably provides all DuPont sites and all global DuPont customers with product and process optimization support, and tests and assesses the entire range of chemical and mechanical capabilities of alloys in the Materials Technology group for all the challenging services at the DuPont production sites.

Lars’s Wish List

- Centralized development of new alloys through one global development conglomerate (“impossible, but wishful thinking at its best!”).
- Alloy-development-company independent batteries of tests proving the usefulness of new alloys under specific conditions.
- Standardized (mechanical and chemical) testing for CRAs (corrosion resistant alloys).
- Better traceability of all raw materials, semi-finished goods, and all intermediate production steps (source of ore, scrap metal content, exact heat treatment, heating and cooling rates, storage times and locations, humidity, etc).
- Standardized EN 10204 / mill sheets template to be used at all mills and manufacturers globally, so the information is legible and always at the same spot, with a minimum requirement for having all local languages translated in parallel into English.
- Less alloys with huge ranges of alloying elements composition.

Keeping up to date on CRAs

Within his area - which spans all of Europe, the Middle East, and Africa (EMEA) – Lars oversees several dozen facilities. These include production facilities for milk products, soy protein, seeds, seed shell products and culture based foodstuffs for nutrition and pharmaceuticals, crop protection products, cleaning aids, specialty gases and monomers, varnishes, block copolymers, high performance elastomers, resins and fluoroproducts, refrigerants and intermediary compounds.

“The MTI (Materials Testing Institute) and affiliated activities such as EUROTAC and Stainless Steel World Conference help to keep me up to date with the most critical corrosion and other degradation mechanisms.

The aging of plants is an issue the industry has to deal with every day, requiring detailed inspections that are a regular routine for Lars. Photo: Dirk Willem Bikker.

Lars Rose: “The underlying degradation mechanisms at chemical plants across the industry are very similar, only the severity changes.” Photo: Heidrun Spohr
Furthermore, we are responsible for keeping our sites up to date with the most current RAGAGEPs (Recognized And Generally Accepted Good Engineering Practices) and legislations, so we purchase the regularly updated legal codes of all countries through external suppliers and regularly review them during the audits we lead in the region.”

While it’s challenging dealing with different products, in the long run each plant is similar. “Each site has common concerns such as corrosion, issues with O-rings or FRP (Fiber Reinforced Polymer) vessels; or there may be problems with stainless steel pitting or higher alloys cracking. From a materials point of view: the underlying degradation mechanisms at chemical plants across the industry are very similar, only the severity changes.”

“Aqueous hydrofluoric acid is one of the most corrosive products we have and requires a wide range of alloys. We monitor the material and replace it preventatively, but stainless steel simply wouldn’t last long in this application.” While Lars is dealing with a huge range of corrosive materials, seemingly harmless products can also be a headache. “Simple bacteria from milk fermentation processes and the cleaning chemicals used in the dairy and food industries may cause significant corrosion to stainless steels, so specialty alloys may be required for food-related services.”

Every plant has one central go-to person in close contact with Lars to exchange information and requests. DuPont also offers teaching modules to individual groups at the sites, and holds centralized educational conferences to share knowledge.

“We all keep on learning. I now give the training to staff and that has really helped me to gain a much broader and deeper understanding of the issues we face. If we receive training, we may retain 20 % of the knowledge, but if we give the training we actually retain 90 % of the knowledge.”

CUI: corrosion under insulation
One of the main issues Lars faces is a problem that has existed since the first chemical plants were built: Corrosion Under Insulation (CUI), both in carbon steel and stainless steel. “CUI is the most common form of corrosion at all chemical facilities, particularly aging facilities which are largely constructed in carbon steel. Over 10 % of any maintenance budget goes directly toward addressing CUI across all industries. With carbon steel you see the material peeling away in fist size chunks but with stainless steel we see stress corrosion cracking, which is often barely visible in standard inspections. The problem with stainless steel is that if moisture combined with a small amount of chloride is present under the insulation and the temperature rises above a certain point, chloride stress corrosion cracking will occur. It’s difficult to detect because the metal can still look good.”

“We have developed training to recognize this problem, and tools to identify it in the field with specific inspection methods. MTI has formed a task group to review the correlation of the typical age of facilities with the quantity of problems arising from CUI as a dependence of the material of choice, type of industry, geographical location etc. Furthermore, through MTI, we have seen a strong surge towards the use of thermally sprayed aluminum to protect carbon and stainless steel to prevent CUI from occurring. It lasts longer than any paint and is easy to apply.”

“The chemical industry is still missing some tools to tackle CUI. Sure, we can strip the insulation and assess the state of the equipment visually or with ultrasound or Eddy Currents, but I hope that one day we will be able to inspect under insulation without having to remove it.

Infrared scans or radiographic methods are good to start with, but they come with their limitations. Guided wave technology, just to name one example, allows us to remove only a small amount of insulation from a pipe and then inspect a couple of meters, but we are unable to inspect kilometers of pipe from a single emission/detection source. A big advantage today is that we can now scan tank bottoms without having to empty them, but this technology is also still in its infancy, and is limited to large defects.”

Dairy processing challenges
Given the wide range of mediums that the DuPont plants process, who would have thought that milk would be such a difficult product to handle?

“DuPont is one of the global leaders in ingredients for the food and beverage industry and is an expert that develops marketable research ideas into full-scale products and technologies. Photo: Lars Rose

DuPont Engineering Technology is a large group of global experts that develops marketable research ideas into full-scale products and technologies.
industry, with expertise in probiotic cultures, vitamins, emulgifiers, enzymes, protein isolates, soy products, specialty hydrocarbons, sweeteners, and gum, just to name a few. The main challenge to be dealt with in the case of dairy products is contamination. You need to ensure that all pipes are cleaned very well and that there are no locations in the facility where organic material can grow. Contamination can occur in a multitude of ways; for instance when milk is heated a thin skin forms on the surface which becomes sticky. The proteins in milk may polymerize and sugar may caramelize. You also have fats and reagents present depending on the products being processed; these can cause deposits with a rough surface which attracts further contaminants. Sweet syrups may harden which encourages bacteria to grow. To summarize, you need to take care that your cleaning system works extremely well.”

Dairy processing across the industry globally utilizes standard grades of stainless steel - 316 or 304 – as these are approved as safe for use with foodstuffs. They have been proven to perform very well, and are also able to withstand the very aggressive cleaning required in factories processing dairy products.

**Material specification**

“The ‘run of the mill’ 304 and 316 stainless steels are by far the most common stainless steels used by the food industry,” continues Lars. “Special nickel, chromium, cobalt, molybdenum, titanium, zirconium, tantalum, or other alloys are only required when the standard stainless steels are insufficient for their services.”

“During project planning we sit together as a team and discuss what to buy, which grade, whether specialty metals are required. It always depends on the circumstances, the individual needs of the process and the best option for successful production. For instance ensuring alloys are food safe often requires a huge amount of work.”

“For most applications standard 316 stainless steels are perfectly adequate. If higher alloy stainless steels are required, the higher price and longer lead times are often unsatisfactory given the small global volume. Titanium is rarely specified in chemical plants due to its high cost and sometimes less than optimal corrosion resistance. While 13Cr is extensively used in the oil and gas industry, it is not typically used in the dairy industry.”

“Specialty alloys are excellent in corrosive and high temperature applications; the downsides are the long lead times, high cost and volatile price fluctuations which discourage suppliers from purchasing the material in the first place.”

“While lean duplex is a great alternative to carbon steel, especially for large structures such as storage tanks, the higher initial cost makes them unfortunately less attractive in comparison to regular stainless steels. Cost remains the main factor. I often recommend duplex and as a material it’s fantastic. Overall it costs perhaps 20% more but it is excellent to use, especially for storage tanks.”

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“To summarize, the main challenges we face with CRAs are high costs, variability in prices, variability in alloy quality (even from the same manufacturer), uncertainty in alloy quality control, and a whole slew of new alloys that promise to solve specific problems (such as coking or metal dusting) but may actually perform worse than established alloys in the plants, despite promising lab testing.”