DX2202

Shaping the Future of Stainless Steels for Wastewater Treatment Applications

The Results Are In!

According to an independent, EU-funded study, Aperam's Lean Duplex DX2202 (1.4062) grade of stainless steel offers the same level of corrosion resistance as the 316L austenitic grade when used in wastewater treatment applications.

As a result, it is the best alternative to austenitic grades for use with this type of application.

Read more

Dr. Audrey Allion

Dr. Charles David

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A Major Market Transformation Is Underway

A new study published by Materials and Corrosion, a leading European journal in its field, leaves no room for doubt: Aperam's DX2202 grade of Lean Duplex stainless steel offers similar localized corrosion resistance as the 316L austenitic grade (in the environment used for this study). As a result, and in addition to its price competitiveness, Lean Duplex DX2202 is a good candidate to replace 316L in water treatment applications. The independent study was led by the French Corrosion Institute and done in collaboration with Veolia, a leading environmental engineering company with a deep expertise in water and wastewater treatment applications.

To learn more about what this study means for stainless steel, Aperam, and end users, we sat down with **Dr. Audrey Allion**, who co-authored the report, and **Dr. Charles David**, who heads Aperam's Lean Duplex customer technical support team.

Why was this independent study carried out and how was it organized?

Dr. Allion: When it comes to wastewater treatment applications, Lean Duplex stainless steels are well-positioned to serve as a good alternative to the more commonly used austenitic grades. However, despite the advantages they offer, uptake remains low – probably due to the fact that there are very few – if any – case studies on using duplex grades in wastewater applications.

This study aimed to change that by clearly defining the limits of using Lean Duplexes for urban wastewater treatment units. The study is an initiative of seven partners, including two of Europe's leading stainless steel manufacturers and end user Veolia. It was led by the French Corrosion Institute.

What is localized corrosion and why is it important for such applications?

Dr. Allion: Uniform corrosion in stainless steel is usually negligible, down to a pH of about 4, meaning it is not an issue for most types of environments. However, depending on such factors as temperature, pH, aggressive ion concentration (mainly chloride) and the composition of the stainless steel, localized corrosion can occur.

Take for instance crevice corrosion, a type of localized corrosion that often occurs in an application's confined spaces (i.e., crevices). Because these spaces have limited access to the oxygen needed for repassivation, the phenomenon that forms the protection layer that allows the material to resist corrosion, crevice corrosion occurs. This also increases the aggressive anion content, which creates a harsher environment. As a result, localized corrosion has traditionally been a key factor in stainless steels' wide-spread use with wastewater treatment applications.

What are the main outcomes of the study?

Dr. Allion: This study compared the localized corrosion performance of the selected Lean Duplexes to that of austenitic grades 304L and 316L (and with DX2304 and DX2205). The materials underwent field testing in municipal wastewater plants (WWTP) for a period of 1 year, during which time they were subjected to both low and high chloride content units representative of standard and harsh conditions. Samples of each grade were also fully immersed in the pre-treatment buildings located at the inlet works (the screen step used to remove large particles). Concentrations of chloride and H_2S were about 10 times higher in the harsh WWTP than in the standard one. What we found was that similar localized corrosion resistance was observed between the 316L and DX2202 grade samples featuring crevice configuration or welded coupons. The study also included substantial lab tests that used simulated water systems based on Veolia's recommendations. These simulated lab tests provided similar results to what we gained from our field tests, further verifying our testing methods – and results.

Are there other advantages of using DX2202?

Dr. David: Like other duplexes, Lean Duplexes differ from other stainless steel grades in that their microstructure has two phases instead of just one. Similar to composite materials, this dual-phase structure gives Lean Duplexes mechanical properties that simply cannot be obtained when each material is used separately. This is why these grades have about twice the mechanical resistance as their austenitic counterparts, allowing thickness reduction in some cases.

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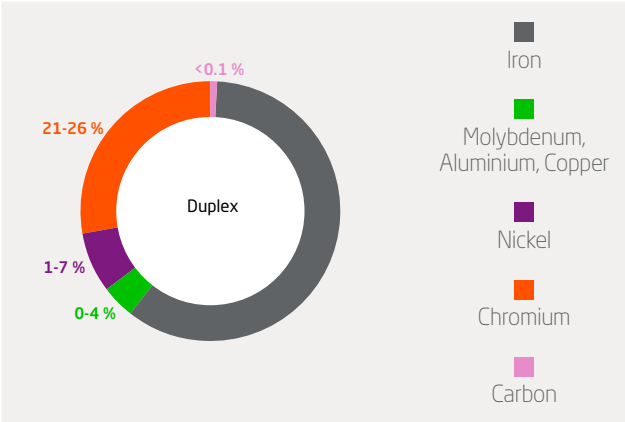
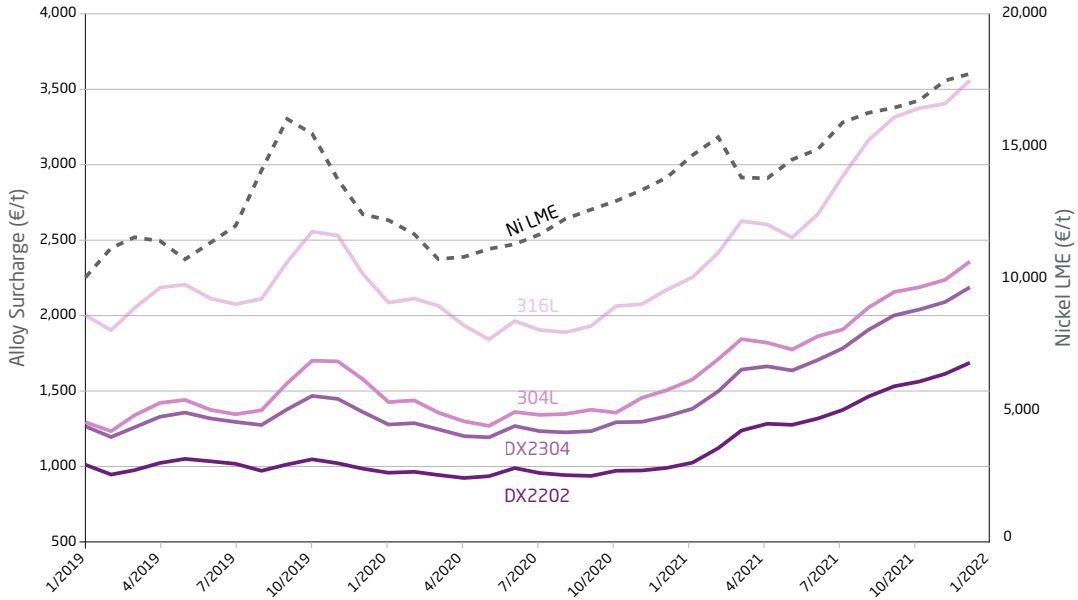
How can Lean Duplexes perform so well when their nickel content is so low?

Dr. David: When it comes to corrosion, stainless steel's behaviour mostly depends on its chromium content. The higher it is, the stronger the chromium oxide layer and the better it is able to protect the metal from corrosion initiation. Advancements in the industrial techniques for producing stainless steel have allowed us to merge the best of two worlds: excellent mechanical properties without the need for high nickel content, and high corrosion resistance thanks to the possibility of increasing the chromium percentage.



What about DX2202's price competitiveness? Does it offer economic advantages over austenitic grades?

Dr. David: Because DX2202 replaces the mechanical contribution of nickel with a dual-phase structure, it is able to offer considerable savings in terms of raw material cost. Despite the fact that Lean Duplex grades require unique know-how and special production methods, the resulting enhanced corrosion resistance makes for a very competitively priced stainless steel. In this way, DX2202 is often cheaper than 304L and 316L, especially when nickel price is high. Furthermore, Lean Duplex are much less impacted by nickel price fluctuations, as illustrated below.



DX2202 is Easy to Weld!

- No risk of precipitating sigma phase during welding
- No preheating and (usually) no post-weld heat treatment required
- Can be welded to austenitic stainless steels, other duplexes and carbon steels
- Welding consumables are widely available
- Backing gas can be pure Nitrogen (cheaper than Argon)
- Shielding gas mix containing nitrogen (2-3% usually) is recommended and available from your usual welding gas provider

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Best in Class R&D

In conducting our research on Duplex stainless steels, Aperam counts on some of the most leading academic players in their fields. Duplex - built on experience and in collaboration with our top-level partners:

UCLouvain · The University of Oklahoma · Institut de Soudure Groupe · Chimie Paris ParisTech | PSL · Grenoble INP phelma · Mines Saint-Étienne · Institut de la Corrosion French Corrosion Institute · INSA Institut National des Sciences Appliquées Lyon · uB Université de Bourgogne

To learn more, please contact **charles.david@aperam.com**

NEW!

All information regarding Aperam's scientific work on Duplex can now be found in one place!

Check here for the latest results, scientific papers, conference papers and presentations - and more!

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