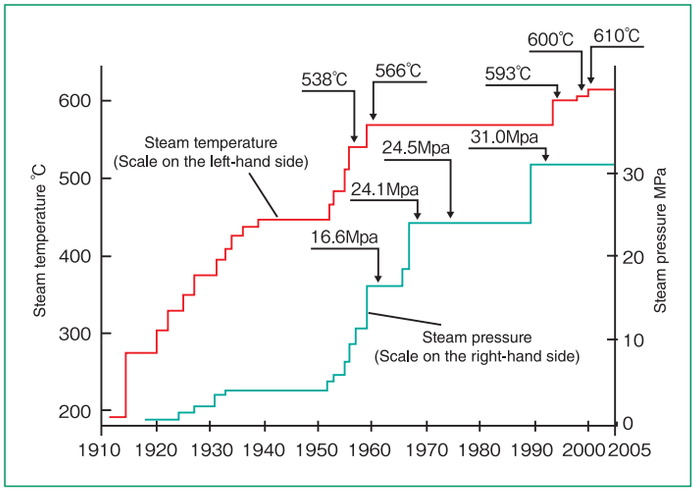
Reducing CO_2 emissions by developing stainless steel pipes that maintain a high level of strength at high temperatures and increasing the operating temperature of thermal power generation to 600°C to raise energy efficiency

Stainless Steel Tubes for USC Boilers

Applicable field
Thermal power generation boilers, other heat exchanging equipment

Features

- The new tubes enable the boiler operating temperature to be raised from the conventional 566°C (supercritical pressure) to 600°C(ultra-supercritical pressure, or USC) by providing both high strength and high corrosion resistance under high-temperature conditions.
- We developed several series of innovative materials with high strength and corrosion resistance for use in a variety of applications (TP347HFG, SUPER304H, HR3C).
- The new tubes have facilitated a reduction in global CO_2 emissions of approximately 66.4 million tons per year (in Japan, 4.6 million tons per year) by improving the generating efficiency of boilers by 4% compared to conventional technologies.



Transition of Steam Conditions in Japan

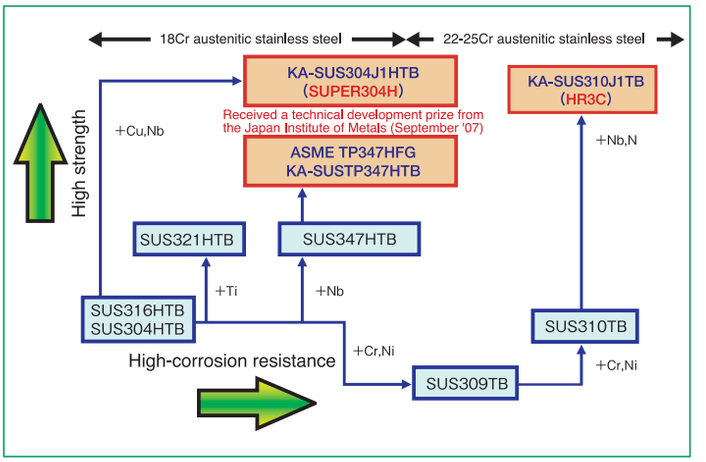
Overview (Technical principles, actions, etc.)

A thermal power boiler generates electricity by burning fuel, such as coal or oil, and producing steam. If the temperature of high-pressure (supercritical-pressure) steam, conventionally available at 566°C, is increased to 600°C (at ultra-supercritical pressure, or USC), the thermal efficiency of the boiler will increase and greatly reduces CO_2 emissions. These products are applied to integral components of the USC boiler, such as superheater tubes, which generate high-temperature and high-pressure steam, thus enabling the operation of the USC boiler at 600°C. Neither the high-temperature strength nor corrosion resistance (steam oxidation resistance) of conventional types of steel is sufficient, and that is the reason the conventional types of steel are not used at temperatures in excess of 600°C. Sumitomo Metal developed three new types of steel to support the necessary characteristics of each component of the USC boiler.

①TP347HFG, which was developed by optimizing alloying elements within the standardized ingredient range of the conventional types of steel and applying special heat treatment, has 1.3 times the strength of the conventional types of steel.

②SUPER304H, which was developed by adding copper and nitrogen while dramatically reducing high-priced nickel content and applying special heat treatment, has twice the strength and corrosion resistance of the conventional types of steel.

③HR3C as high-chromium steel in the highest class realized with a fine precipitate is applied to components where elements, such as S, contained in the fuel cause high-temperature corrosion. A practical performance test of HR3C tubes for over 13 years demonstrated the high quality of the tubes.



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Introductory Track Record

- **TP347HFG, which has fine-grained microstracture patented in Japan and overseas, has been officially registered under ASME/ASTM international standards (the first time a privately developed steel has achieved this distinction).**
- **In addition to being registered under ASME/ASTM standards, SUPER304H and HR3C have been registered under European TUV standards and are well-known standard materials worldwide for use in 600°C class USC boilers. They are in use at 20 power plants operating in Japan, and plans call for significant adoption of the newly developed steel grades to be employed at new boilers being constructed in Europe, China, and other locations worldwide in the coming years. In the current rush to build thermal power generation boilers to meet increased energy demand worldwide, this development project is expected to reduce CO_2 emissions on a global scale. (Domestic share: 100%; global share: 80%)**

Effects

◎**Use of the new steel grades has made possible high-temperature, high-pressure 600°C USC boilers. Improvements in generating efficiency (of 4% compared to conventional technologies) have enabled a reduction in Japanese coal consumption of 3.98 million tons per year.**

◎**The new steel grades have become a world standard, capturing approximately 100% of the Japanese market and more than 80% of the global market for use in USC boilers, which are experiencing an ongoing construction boom worldwide. There are 80 boilers currently in operation around the world, a number that increases to 191 if planned systems are included. The technology will reduce coal consumption at these 191 power plants by 27.7 million tons per year, and there is no doubt that its contribution to reducing the environmental impact of power generation will continue to grow.**

◎**It is estimated that improvements in boiler generating efficiency will reduce CO_2 emissions by 4.6 millions tons per year in Japan and 66.64 million tons per year worldwide.**

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