KANTHAL®

EXTENDED TUBE SERVICE LIFE IN GAS FIRED-RADIANT TUBE APPLICATIONS

KANTHAL® APM AND KANTHAL® APMT TUBES

TUBE DESIGN FOR EFFICIENT FURNACE PRODUCTION

Kanthal offers a broad range of radiant tube alternatives for trouble-free and uninterrupted furnace operation in the heat treatment, steel and aluminum industries. Depending on factors such as temperature, furnace atmospheres and geometries, we can offer cost-efficient solutions for trouble-free use and maximized customer productivity.

Kanthal's radiant tube products are developed to contribute to higher furnace productivity by offering longer service life and allowing higher power output.

KANTHAL® APM

Kanthal® APM is an advanced powder metallurgical, dispersion strengthened, ferritic iron-chromium-aluminum alloy, which is used at tube temperatures up to 1250°C (2280°F). Tubes made from Kanthal® APM have good form stability at high temperatures.

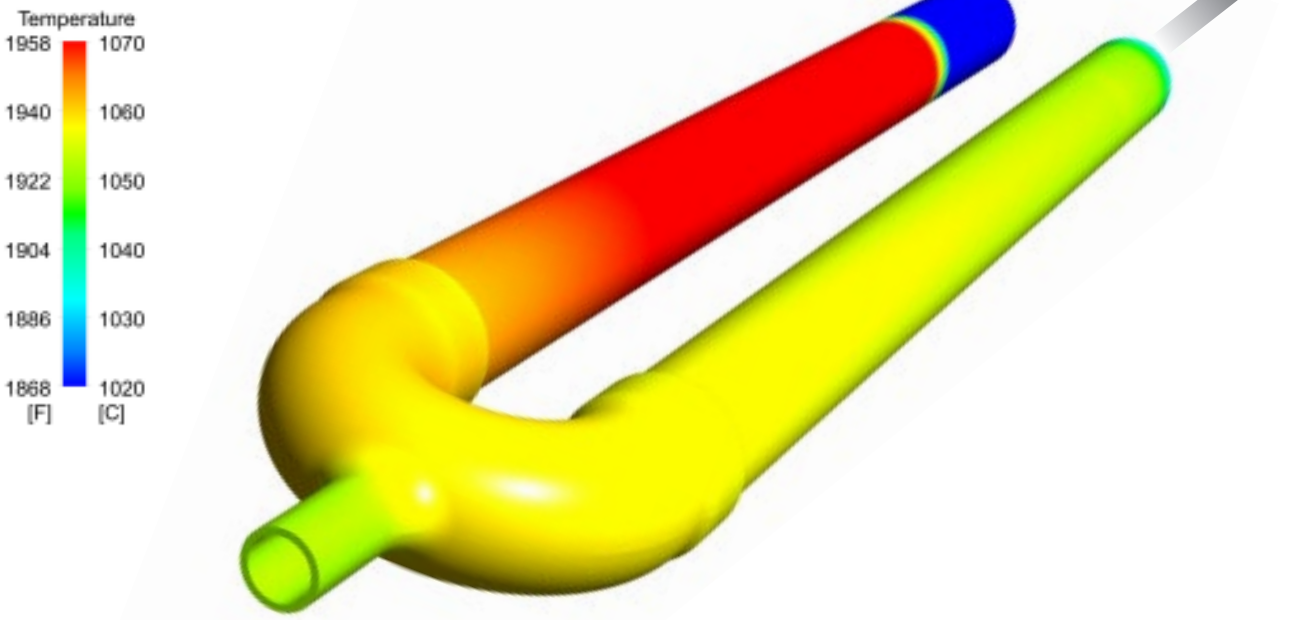
Kanthal® APM forms a non-scaling surface oxide, which provides good protection in most furnace environments, such as oxidizing, sulphidizing and carburizing atmospheres, as well as against deposits like carbon and ash. The combination of excellent oxidation properties and form stability makes the alloy unique.

KANTHAL® APMT

Kanthal® APMT is a further development of Kanthal® APM, designed for especially demanding applications. The alloy has the same excellent high temperature corrosion resistance as Kanthal® APM, but with even higher strength. Kanthal® APMT is designed for applications where a higher mechanical strength is required.

CHALLENGES AND PROBLEMS WITH GAS FIRED RADIANT TUBES

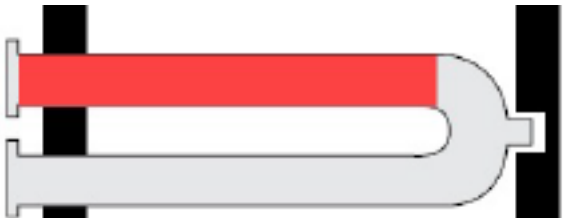
Gas fired radiant tubes are exposed to large temperature gradients along their length. The highest tube temperature and the toughest conditions are reached in the so-called firing leg where the burner is positioned and where the flame is burning. Further down the length of the tube the temperature falls gradually and is less severe. Hence most tube failures are found in the firing leg i.e. the first part of the tube where the temperature is the highest and very seldom in the other sections of the tube where the temperature is lower. This often results in the replacement of the tube once the firing leg has reached its end of life even though the remaining sections are still intact and could be used for months or years to come.



Temperature distribution in a gas fired U-tube.

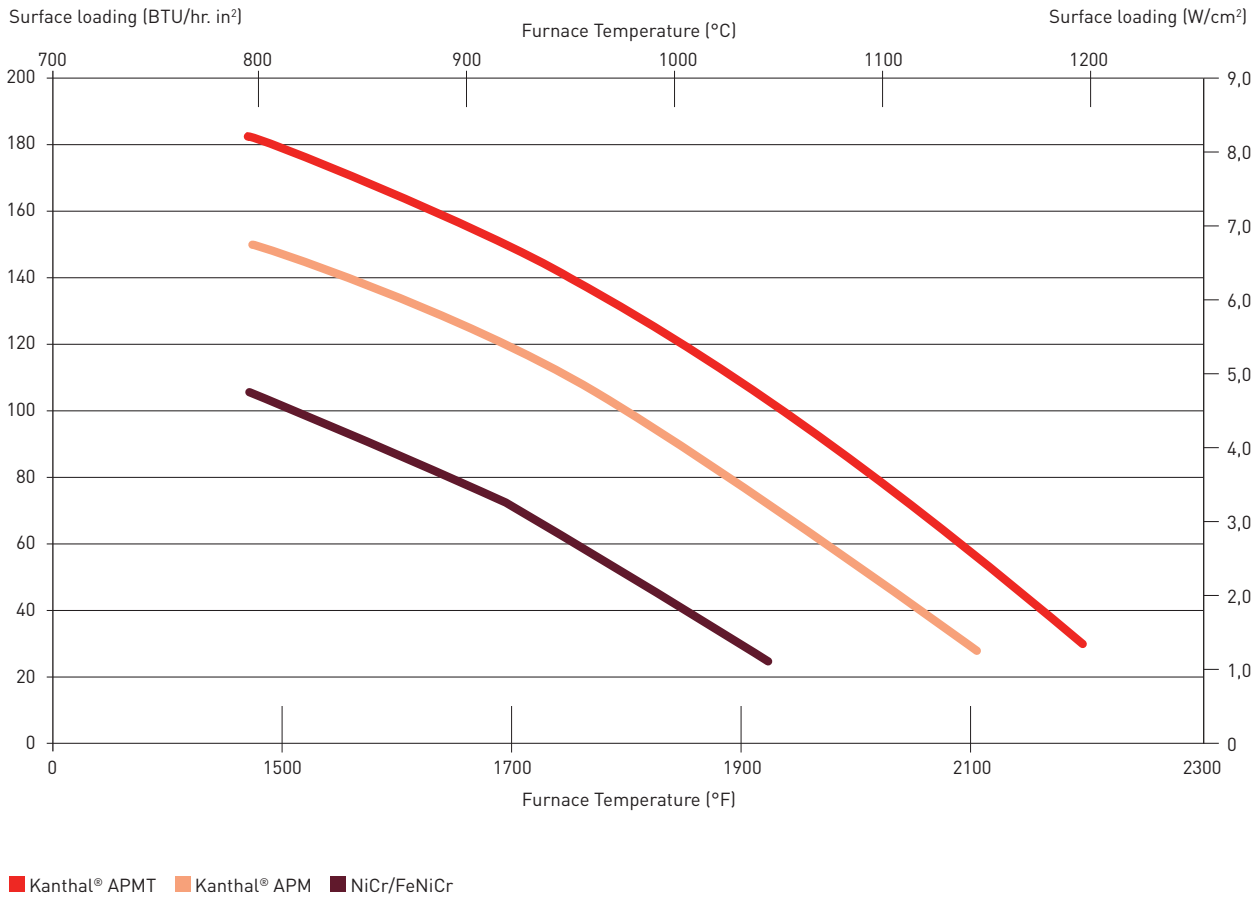
The hybrid gas fired radiant tube design combines the Kanthal® APM or Kanthal® APMT tube in the firing leg, for the toughest conditions, with the conventional NiCr tube material for the sections of the tube where conditions are less severe. This is a solution that brings longer tube service life, reduces furnace downtime and leads to increased furnace productivity and large cost savings.

Typical tube sagging/bending of the firing leg.



U-tube equipped with Kanthal® APM or Kanthal® APMT tube in the firing leg.

MAXIMUM TUBE SURFACE LOADING



STANDARD TUBE SIZES

OD		WALL THICKNESS		WEIGHT				MAX. LENGTH		STANDARD STOCK	
				KANTHAL® APM		KANTHAL® APMT					
MM	IN	MM	IN	KG/M	LB/FT	KG/M	LB/FT	M	FT	KANTHAL® APM	KANTHAL® APMT*
100	3.94	5.0	0.20	10.6	7.12	10.8	7.26	11.5	37.7	•	•
109	4.29	5.0	0.20	11.6	7.79			10.0	32.8	•	
115	4.53	5.5	0.22	13.4	9.00	13.6	9.14	8.0	26.2	•	•
128	5.04	5.5	0.22	15.0	10.08			12.0	39.4	•	
146	5.75	6.0	0.24	18.7	12.57			9.5	31.2	•	
154	6.06	6.0	0.24	19.8	13.30	20.1	13.54	8.0	26.2	•	•
164	6.46	6.0	0.24	21.2	14.25			7.0	23.0	•	
178	7.01	8.0	0.31	30.3	20.36			6.5	21.3	•	
198	7.80	9.0	0.35	37.9	25.47	38.5	25.9	5.0	16.4	•	•

* Tubes in Kanthal® APMT are also available in all sizes. Please contact Kanthal for special requests.

EXTENDED LIFE OF BURNER LEG IN CONTINUOUS ANNEALING FURNACE

The use of Kanthal® APMT and Kanthal® APM for radiant tubes in SSAB's annealing furnace has pro-longed tube life and allowed for fewer furnace shutdowns, as well as the possibility to increase throughput by increasing tube temperature.

THE CHALLENGE

SSAB is a world-leading producer of high-strength and quenched steels. In Borlänge, Sweden, the company operates a continuous annealing line with a nitrogen-hydrogen atmosphere. The furnace is equipped with more than 200 W-shaped gas fired radiant tubes, each providing an output of 180 kW (615,000 BTU/h) giving 35 kW/m^2 (11,100 BTU/h/ft^2), sufficient to maintain a maximum strip temperature of 880°C (1600°F). The maximum radiant tube temperature is 1050°C (1920°F).

In the most demanding zone of the furnace, the average life of the radiant tubes is between 1–4 years. Deformation of the burner leg is the main reason for the exchange of tubes. Three maintenance stops are planned each year, during which 30–50 tubes are replaced annually. Prolonging the life of the radiant tubes would permit SSAB to increase the production time and improve throughput capacity. This could be achieved either by reducing the total number of maintenance stops, and/or by exchanging fewer tubes during each shutdown period.

THE SOLUTION

Kanthal radiant tubes made of Kanthal® APMT or Kanthal® APM offer long service life through excellent oxidation, carburization and high resistance to sagging. Both are advanced powder metallurgical, dispersion strengthened, ferritic iron-chromium-aluminum alloys that can be used at tube temperatures up to 1250°C (2280°F). Kanthal® APMT is the premium alloy with the highest mechanical strength. Two hybrid W-tubes were installed in the highest temperature zone of the furnace, with the burner legs made from Kanthal® APMT and the rest from a nickel-chromium alloy.

THE RESULT

The Kanthal tubes were first inspected after 1.5 years of operation. Measurements showed sagging in the range of 0–2 mm (0–0.1 in). The reference cast tubes (iron-nickel-chromium and iron-nickel-chromium-niobium) had sagged 55–65 mm (2.2–2.6 in) during the same period.

At the inspection after 2.4 years in operation, sagging of the Kanthal® APMT tubes was 0–5 mm (0–0.2 in). The last remaining reference tube had sagged 110 mm (4.3 in), and was replaced. The other references (four in total) were replaced after 1.5–2 years. Extrapolation of the first inspection results indicates a threefold life potential of the W-tubes, and that the life limiting factor is the deformation of the second leg of the cast (nickel-chromium) tube section.

A second test period was started with the additional installation of two all Kanthal® APM W-shaped tubes. It was determined that already Kanthal® APM will considerably prolong the life of the W-tubes to the desired level.

Longer tube life allows for fewer furnace shutdowns. With the new alloys it is also possible to increase the tube temperature, and thereby increase the throughput capability of the furnace.

After 1.5 years of service in the hottest zone of a furnace, the W-tube with the burner leg made of Kanthal® APMT showed a sagging of 0–2 mm (0–0.1 in).

The reference tubes, made of conventional cast material (iron-nickel-chromium), had sagged 55–65 mm (2.2–2.6 in). Two of the reference tubes were replaced after only 1.5 years.

FOR CONTACT INFORMATION PLEASE VISIT:

WWW.KANTHAL.COM

KANTHAL®

07.2021