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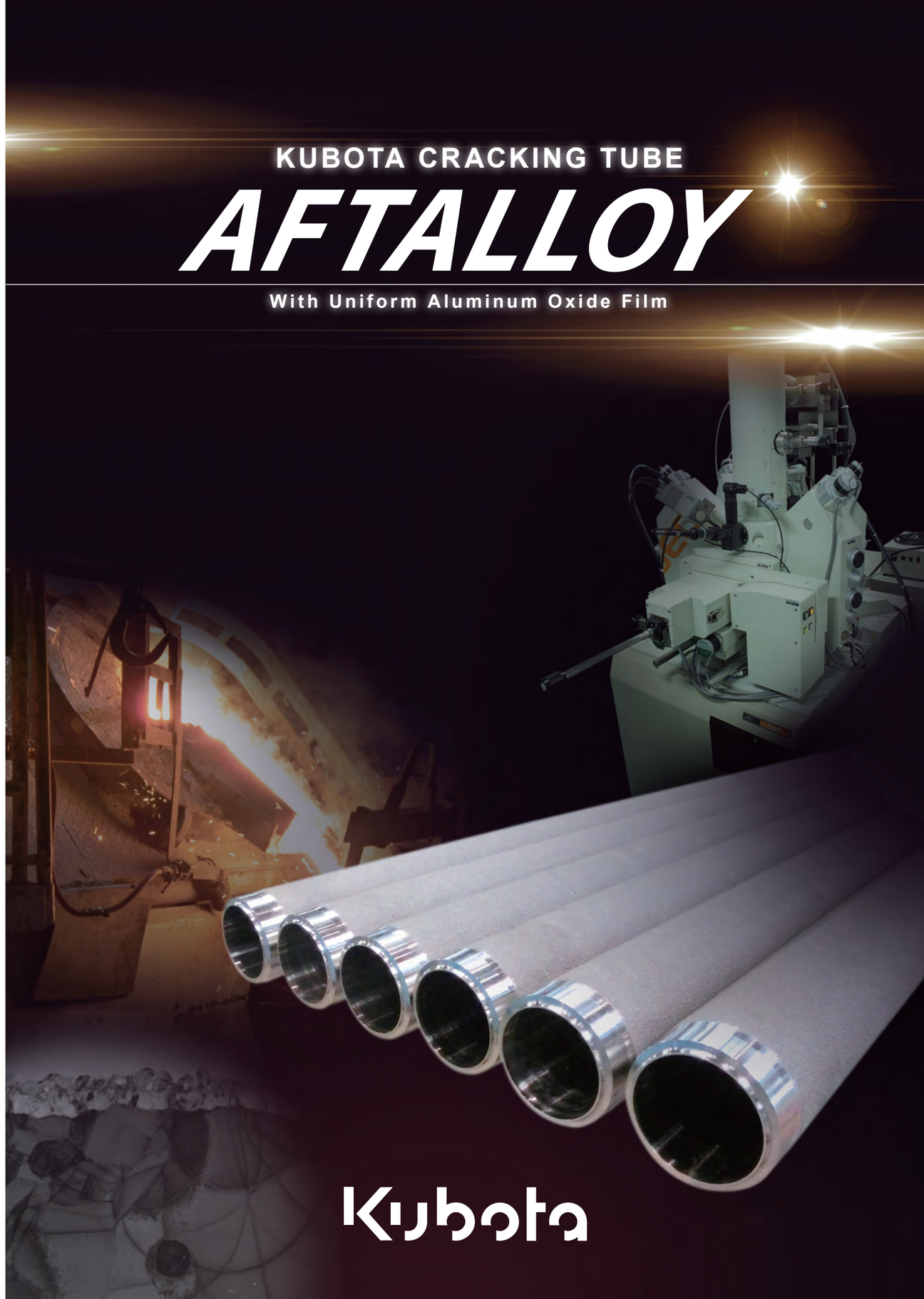
KUBOTA CRACKING TUBE

AFTALLOY

With Uniform Aluminum Oxide Film



Kubota

KUBOTA CRACKING TUBE

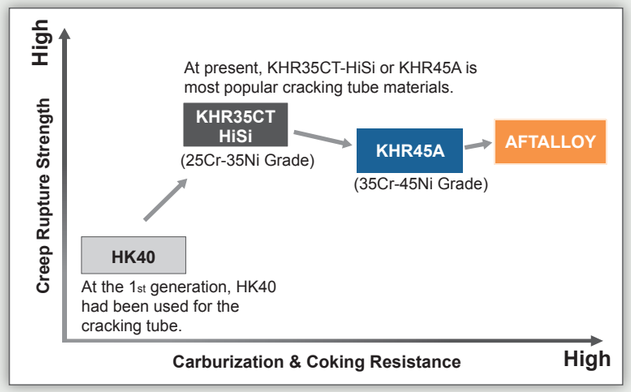
How to exceed the demands of cracking tubes?

AFTALLOY *is the answer.*

Kubota's steel casting business is listening to our customers, aware of the business trends and the requirements of our materials, and is continuously contributing to the development of several industrial fields supplying many unprecedented challenging products. Cracking tubes applied to the petrochemical ethylene plant is one of these main products. They have been supplied since 1965, and Kubota's metal technology has led the market delivering exceptional performance.
AFTALLOY is the next generation cracking tube having a uniform aluminum oxide film on the inside surface. The AFTALLOY offers an alternative to conventional materials, and has excellent carburization resistance and coking resistance.

Advantages of AFTALLOY

Conventional alloys, such a KHR35CT-HiSi or KHR45A, generate chromium oxide at the tube inside surface during high temperature operation. This film reduces coke formation and is effective in resisting carburization. However, this oxide film is not stable above 1080°C and changes to chromium carbide where this benefit is lost. On the other hand, AFTALLOY is produced with an aluminum oxide (Al_2O_3) film. Aluminum oxide is known to have a high melting-point, chemical stability and excellent oxidation, carburization and coking resistance. This superiority in AFTALLOY material performance is expected to improve tube life, run length, and furnace availability.



Research Results of the AFTALLOY Oxide Film

The chemical composition of AFTALLOY and conventional alloys are shown in Table 1. Kubota adds aluminum for the formation of an aluminum oxide film. The cast tube is then subjected to a coating treatment; carefully controlled in the shop. Chemical analysis shows that a uniform, thick, pure Al_2O_3 film is formed on the inside surface of the tube.

SEM and EPMA Results of AFTALLOY

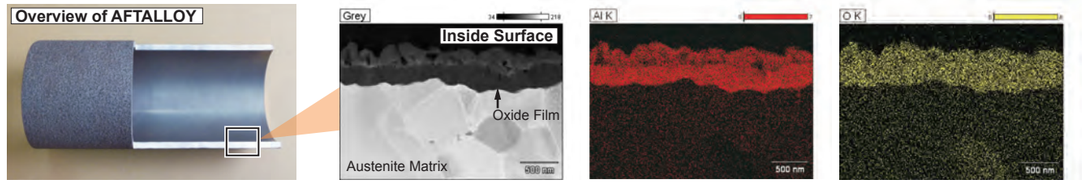
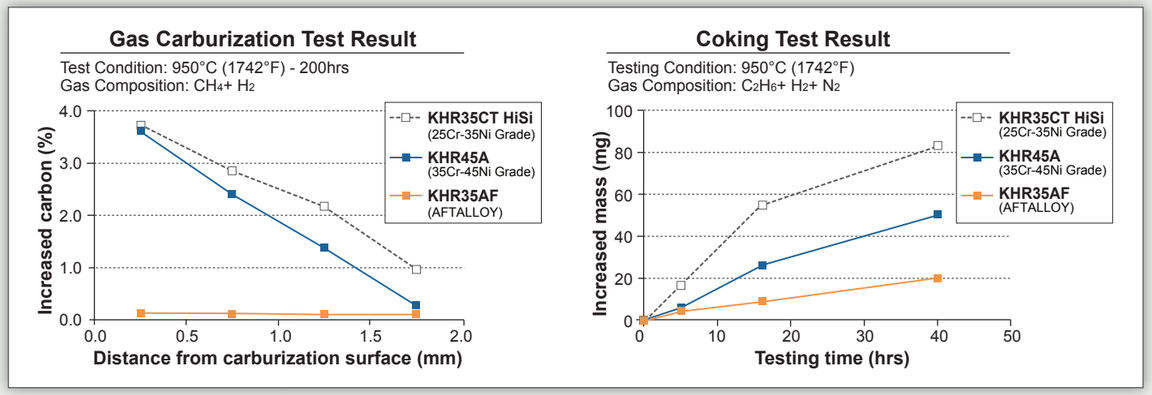


Table.1 Typical Chemical Composition

	C	Si	Mn	Cr	Ni	Nb	Ti	Al	Other
KHR35AF(AFTALLOY)	**0.4-0.6**	**<1.0**	—	**22-28**	**29-37**	**<1.0**	**<0.5**	**2.0-4.0**	**Add.**
KHR45A	0.4-0.6	<2.0	<2.0	30-35	40-46	0.5-1.8	<0.5	<0.5	—
KHR35CT-HiSi	0.45-0.55	1.5-2.0	<2.0	24-27	33-37	<1.0	<0.5	—	—

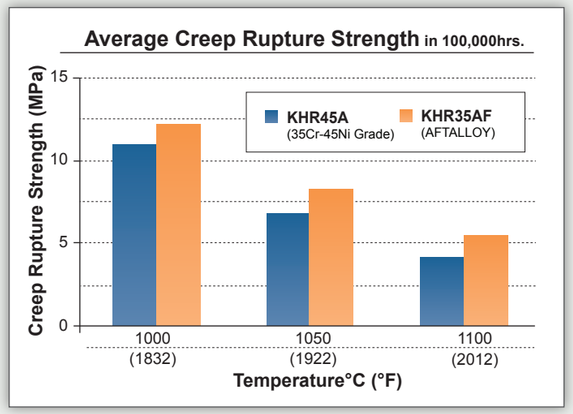
Fundamental Properties

The graphs below show carburization test results and coking test for AFTALLOY.
From the results, AFTALLOY has excellent carburization resistance, much better than conventional alloys. Also, AFTALLOY has excellent coking resistance.



100,000hrs creep rupture strength of AFTALLOY (KHR35AF) is higher than conventional alloys. From this strength and dimensional stability, AFTALLOY can resist bowing at the high temperatures.

Creep Test



Commercial Furnace Case Study – Significant coke reduction was achieved.

AFTALLOY was commercialized in 2011. In 2013, AFTALLOY was installed in the full coil of an ethane cracker. In the furnace, the feed rate was increased by 15% while the dilution steam rate could be lowered.
Tube metal tempature (TMT) and coil inlet pressure (CIP) behavior is shown below. Despite aggressive, higher feed operation, the AFTALLOY furnace, showed a lower rate of TMT increase than the conventional furnace. Operation was stopped due to scheduled decoke after 80 days (original run was 60 days), but the run length of AFTALLOY is expected to reach over 140 days. This is double compared with conventional furnace materials. In addition, the CIP of the AFTALLOY coil was very stable.
Based on this result, an excellent coking resistance was confirmed at commercial furnace.