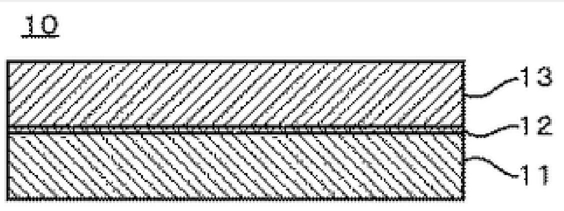
Heating equipment structure

Abstract

PROBLEM TO BE SOLVED: To provide a heating equipment structure that suppresses chemical reaction between chromium and calcium etc., and has good cost performance.SOLUTION: The heating equipment structure includes a metal member which includes at least chromium, a sheet which is formed on the metal member and made of metal, and a main material which is formed on the sheet made of the metal, and includes at least one kind selected out of calcium, potassium, magnesium, and sodium.

Images (1)



JP2012220174A
Japan

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Other languages: English

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Current Assignee : Toshiba Corp.

Worldwide applications

2011 • JP

Application JP2011089974A events

2011-04-14	Application filed by Toshiba Corp.
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Info: Patent citations (8), Cited by (2), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (5)

Hide Dependent

translated from Japanese

A metal member containing at least chromium;
A sheet made of metal and formed on the metal member;
A heat insulating material formed on the metal sheet and containing at least one selected from calcium, potassium, magnesium, and sodium;
A thermal equipment structure comprising: The thermal equipment structure according to claim 1, wherein the heat insulating material has a porosity of 80% or more. The thermal equipment structure according to claim 1 or 2, wherein the metal member is stainless steel. The thermal insulation structure according to any one of claims 1 to 3, wherein the heat insulating material contains a composite oxide of calcium oxide and silicon oxide as a main component. The thermal equipment structure according to any one of claims 1 to 4, wherein the sheet made of metal contains iron or nickel as a main component.

Description

translated from Japanese

The present invention relates to a thermal device structure that constitutes a thermal device such as a biomass combustion furnace, a waste incinerator, a thermal power generation device, or a chemical plant.

Thermal equipment using various heats (for example, a biomass combustion furnace, a waste incinerator, a thermal power generation equipment, a chemical plant) is used. For example, in a biomass combustion furnace, attempts are being made to generate electricity using renewable organic resources (biomass) born from animals and plants such as livestock excrement, garbage, and wood scraps.

In general, a metal containing chromium such as stainless steel is often used as a structural material constituting the combustion chamber of these thermal devices from the viewpoint of heat resistance, oxidation resistance, corrosion resistance, high temperature strength, cost, and the like. Moreover, in order not to escape the heat generated in the combustion chamber to the outside, a heat insulating material is disposed outside the stainless steel, so that the generated heat can be effectively used.

Conventionally, asbestos has been used as a heat insulating material for a combustion chamber. Asbestos has been widely used because it is excellent in heat insulation (heat retention characteristics), heat resistance, corrosion resistance, electrical insulation, and the like, and is inexpensive. However, it is no longer used because of its high probability of causing health damage.

At present, as a heat insulating material for a combustion chamber or the like, a heat insulating material mainly composed of calcium silicate (a composite oxide of calcium oxide and silicon oxide) is used. This is because calcium silicate is safe and has excellent heat insulation (heat retention characteristics), heat resistance and corrosion resistance, and is inexpensive.

However, it has been pointed out that hexavalent chromium may be formed when a heat insulating material is brought into contact with a metal containing chromium such as stainless steel in a combustion chamber or the like (for example, non-patent literature). 1). That is, the surface Cr_2O_3 film of stainless steel or the like and the calcium component of the heat insulating material react as follows to form hexavalent chromium.

$2Cr_2O_3 + 4CaO + 3O_2 \rightarrow 4CaCrO_4$

The formation of hexavalent chromium is not limited to biomass combustion furnaces, but occurs in many high-temperature equipment such as waste incinerators, thermal power generation equipment, high-temperature parts of piping equipment, and chemical plants. That is, if there is a structural member containing chromium and a heat insulating material in contact with it and containing calcium, hexavalent chromium may be formed. This phenomenon (formation of hexavalent chromium) becomes more prominent in a metal member having a high chromium content.
This phenomenon is not limited to a heat insulating material containing calcium, but is also observed for a heat insulating material containing potassium, magnesium, and sodium.

For example, the following countermeasures are being studied. (1) Change the material to be used. For example, instead of chromium, molybdenum, silicon, or the like is added to improve corrosion resistance (a metal that does not substantially contain chromium is used). Alternatively, a highly heat-resistant ceramic is used instead of a heat insulating material containing calcium or the like. (2) A cooling system is provided so that the interface between the metal member and the heat insulating material does not reach a high temperature.

"Corrosion Center News", No.034, published on June 1, 2005, Corrosion Protection Association

However, none of the above measures are sufficient, and none of them have been put into practical use. That is, (1) the addition of molybdenum, silicon, etc. and the use of ceramics increase the cost. (2) In the case where a cooling system is provided, the efficiency of the equipment system is lowered at the same time as increasing the cost.

An object of the present invention is to provide a thermal equipment structure in which chemical reactions such as chromium and calcium are suppressed and the cost is excellent.

A thermal equipment structure according to an aspect of the present invention includes a metal member containing at least chromium, a sheet made of metal formed on the metal member, and formed on the sheet made of metal, calcium, potassium, magnesium. And this material containing at least one selected from sodium.

ADVANTAGE OF THE INVENTION According to this invention, chemical reactions, such as chromium and calcium, are suppressed, and the thermal equipment structure excellent in cost can be provided.

It is a transverse cross section showing typically structure 10 concerning one embodiment of the present invention.

The inventors of the present invention have made extensive studies on a method for suppressing the generation of hexavalent chromium caused by the reaction between a metal member and a heat insulating material in a thermal apparatus. As a result, it has been found that by forming a sheet made of metal on the surface of the metal member, the chromium component present on the surface of the metal member and the calcium component in the heat insulating material can be isolated and the generation of hexavalent chromium can be suppressed.

FIG. 1 is a cross-sectional view schematically showing a structure 10 according to an embodiment of the present invention. The structure 10 constitutes a biomass combustion furnace, a waste incinerator, a high-temperature part of a thermal power generation device or a piping device, a thermal device (especially its combustion chamber) such as a chemical plant, a metal member 11, a metal sheet 12, and a thermal insulation. A material 13 is provided.

The metal member 11 contains at least chromium. The metal member 11 is preferably stainless steel. This is because stainless steel is excellent in heat resistance, corrosion resistance, and high-temperature strength, and at the same time is relatively inexpensive. Here, stainless steel is defined as steel containing 11% or more of chromium, and is classified into martensitic stainless steel, ferritic stainless steel, austenitic stainless steel, austenitic / ferritic duplex stainless steel, and precipitation hardened stainless steel. .

The metal sheet 12 is a sheet made of a metal such as iron or nickel, and is disposed on the surface of the metal member 11. The metal sheet 12 may be dense, but may be porous (having pores). By making the metal sheet 12 porous, the path length of the diffusion of chromium (in the metal sheet 12) from the metal member 11 to the heat insulating material 13 becomes longer, and the thickness of the metal sheet 12 can be made larger than when it is made dense. It can be reduced.

Here, the thickness of the metal sheet 12 is preferably 1 μm or more and 1 mm or less. If the thickness of the metal sheet 12 is less than 1 μm, the following problem may occur. That is, the strength of the metal sheet 12 is weak, and there is a possibility that tearing or the like may occur when the metal sheet 12 is disposed on the metal member. Moreover, the diffusion distance of chromium (the thickness of the metal sheet 12) is short, and it becomes difficult to obtain a sufficient reaction suppression effect. On the other hand, if the thickness of the metal sheet 12 is greater than 1 mm, it cannot be applied to a complicated shape such as a curved surface, and it is difficult to substantially perform the reaction suppressing function.

The heat insulating material 13 is a member (heat insulating member) for restricting the movement of heat generated in the thermal equipment to the outside. For this reason, the heat insulating material 13 has a large number of holes therein. The porosity of the heat insulating material 13 (ratio indicated by the voids in the volume of the heat insulating material 13, also referred to as porosity) is preferably 80% or more, more preferably 90% or more.

The heat insulating material 13 includes at least one selected from calcium, potassium, magnesium, and sodium, and is disposed in contact with the metal sheet 12. Here, the heat insulating material 13 is preferably composed mainly of a composite oxide of calcium oxide and silicon oxide. This is because the heat insulating material mainly composed of a composite oxide of calcium oxide and silicon oxide has an excellent heat insulating effect and at the same time has excellent heat resistance, oxidation resistance, high temperature strength, etc., and is relatively inexpensive. Because.

Next, a method for forming the structure 10 will be described.
The structure 10 is formed by the arrangement of the metal sheet 12 on the metal member 11 and the arrangement of the heat insulating material 13 on the metal sheet 12.

The heat insulating material 13 is fixed to the metal sheet 12 (metal member 11). That is, the metal member 11 and the heat insulating material 13 are disposed on the front and back surfaces of the metal sheet 12, and the metal sheet 12 prevents the metal member 11 and the heat insulating material 13 from contacting each other. A mechanical method can be used for this fixing. The metal sheet 12 is arranged on the metal member 11, the heat insulating material 13 is further arranged on the metal sheet 12, and the heat insulating material 13 is wound around the metal member 11 by winding a wire made of a heat resistant metal such as nickel. Fixed.

Examples of the present invention will be described below.

Example 1
A pure nickel sheet having a thickness of 200 μm was disposed on the entire surface of a SUS304 square plate specimen having dimensions of 50 × 50 × 10 mm. Furthermore, a heat insulating material (trade name: Rockwool) mainly composed of a composite oxide of calcium oxide and silicon oxide was prepared, processed to a size of 50 × 50 × 10 mm, and then placed on a nickel sheet. This was heat-treated in the atmosphere. The heat treatment conditions were 600 ° C. and 500 hours.

After the heat treatment, the contact surfaces of both the stainless steel SUS304 steel square plate specimen and the heat insulating material mainly composed of a composite oxide of calcium oxide and silicon oxide were visually observed. As a result, no change in color due to the reaction product or the like was observed.

(Example 2)
Evaluation was made in the same manner as in Example 1 except that the material of the heat insulating material was trade name water-repellent perlite (SiO_2 was the main component and Na_2O was contained about 7%). As a result, no change in color due to the reaction product or the like was observed.

(Example 3)
The reaction was evaluated in the same manner as in Example 1 except that the material of the heat insulating material was the trade name Keical Ace Super Silica (calcium silicate as a main component and a small amount of potassium). As a result, no change in color due to the reaction product or the like was observed.

(Comparative Example 1)
In Example 1, exactly the same conditions except that a SUS304 square plate specimen and a heat insulating material (commercial name: rock wool) mainly composed of a composite oxide of calcium oxide and silicon oxide were contacted directly without using a nickel sheet. Heat treatment was performed at

After the heat treatment, the contact surfaces of both the stainless steel SUS304 steel square plate specimen and the heat insulating material mainly composed of a composite oxide of calcium oxide and silicon oxide were visually observed. As a result, a yellow substance was confirmed on the heat insulating material side. When this yellow substance was collected and analyzed by X-ray diffraction, it was confirmed to be hexavalent chromium.

(Comparative Example 2)
Evaluation was made in the same manner as in Comparative Example 1 except that the material of the heat insulating material was trade name water-repellent perlite (SiO_2 was the main component and Na_2O was contained in about 7%). As a result, a complex oxide of chromium and sodium was observed by X-ray diffraction.

(Comparative Example 3)
Evaluation was made in the same manner as in Comparative Example 1 except that the material of the heat insulating material was trade name Keical Ace Super Silica (calcium silicate as a main component and a small amount of potassium). As a result, a complex oxide of chromium and calcium was observed by X-ray diffraction. A trace amount of complex oxide of chromium and potassium was also detected.

(Other embodiments)
Embodiments of the present invention are not limited to the above-described embodiments, and can be expanded and modified. The expanded and modified embodiments are also included in the technical scope of the present invention.

DESCRIPTION OF SYMBOLS 10 Structure 11 Metal member 12 Metal sheet 13 Heat insulating material

Patent Citations (8)

Publication number	Priority dates	Publication date	Assignee	Title
JPS6190832U *	1984-11-19	1986-06-12		
JPH11350106A *	1998-06-04	1999-12-21	Hitachi Ltd.	Production of structural members
JP2001349675A *	2000-06-09	2001-12-21	Kawasaki Heavy Industries Ltd.	External heating rotary kiln
JP2002241961A *	2000-12-23	2002-08-28	Alstom Power Nv	Protective layer for component to be subjected to thermal load, particularly for turbine blade
JP2003042403A *	2001-07-25	2003-02-13	Babcock Hitachi Kk	Furnace-wall structural material and furnace structure comprising structural material

JP2004182528A *	2002-12-03	2004-07-02	Ebara Ballard Corp	Fuel treating equipment
JP2004339018A *	2003-05-16	2004-12-02	Matsushita Electric Ind Co Ltd	Porous structure and composite material provided with the same
JP2009293058A *	2008-06-03	2009-12-17	Fujifilm Corp	Ceramic laminate, and structure for thermal barrier coating
Family To Family Citations				

* Cited by examiner, † Cited by third party

Cited By (2)

Publication number	Priority date	Publication date	Assignee	Title
LU500133A1	2020-06-16	2021-12-16	Ingrid Lipp	Metal hot part insulation element to prevent or reduce the formation of heavy metal compounds that are harmful to the environment and/or health
WO2021255125A1	2020-06-16	2021-12-23	Ingrid Lipp	Hot-metal-part insulating element for preventing or reducing the formation of heavy-metal compounds which are harmful to the environment and/or to health
Family To Family Citations				

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
Farmer et al.	2014	Scoping assessments of ATF impact on late-stage accident progression including molten core–concrete interaction
Jiamin et al.	2009	Corrosion behavior of TP316L of superheater in biomass boiler with simulated atmosphere and deposit
JP5774355B2	2015-09-09	Thermal equipment structure
Singh et al.	2013	High temperature corrosion behavior of Ni-based superalloy Superni-75 in the real service environment of medical waste incinerator
Nguyen et al.	2015	Water vapor effects on corrosion of Fe–Cr and Fe–Cr–Ni alloys containing silicon in CO_2 gas at 818° C
Shi et al.	2015	High temperature oxidation behavior of SIMP steel
Hong et al.	2019	Failure analysis of a water wall boiler tube for power generation in a district heating system

Malede et al.	2018	Effect of microstructure on KCl corrosion attack of modified AISI 310 steel
JP5611877B2	2014-10-22	Thermal equipment structural member and manufacturing method thereof
Singh et al.	2014	Behavior of Ni-based superalloys in an actual waste incinerator plant under cyclic conditions for 1,000 h at 900 C
Wu et al.	2015	Laboratory studies of potassium-halide-induced high-temperature corrosion of superheater steels. Part 1: exposures in dry air
CN112144008A	2020-12-29	Method for improving high-temperature-resistant liquid metal corrosion resistance of oxide dispersion strengthened steel through pre-oxidation
JP2014157002A	2014-08-28	Joined body and thermal equipment structure
Ma et al.	2021	Investigation on High Temperature Corrosion Characteristic of Super304H, TP347H, and HR3C Steel in an Ultra-supercritical Coal-fired Boiler ▲
Sudiro et al.	2013	A comparative study of high temperature corrosion of Al2O3, SiO2 and Al2O3–SiO2 forming alloys in a Na2SO4–NaCl atmosphere
Pint et al.	2021	Pre-Oxidation to Improve Liquid Metal Compatibility
Khadom et al.	2016	Retardation of high-temperature fuel ash corrosion of fireside boiler tubes via nanoparticles
KR101223263B1	2013-01-17	Thermal insulator for pipes
Jamrozik et al.	2014	Evaluation of the applicability of Sanicro 25 steel in supercritical boilers
Li et al.	2019	The influence of Cu content on high temperature corrosion behavior of heat-resistant molten salt steel
Liu et al.	2018	Impacts of temperature and KCl on corrosion behavior of 12Cr1MoVG and T91 in HCl-containing atmosphere
Wu et al.	2020	High-temperature corrosion behaviors of typical nickel alloy coatings in a simulated boiler coal ash/gas environment in the Zhundong region
Chen et al.	2022	Research on the gas–solid corrosion characteristics of 316L alloy fiber filter bags in halogen hydride atmosphere
Pint et al.	2018	Steam Oxidation and Burst Testing in the Severe Accident Test Station
Lehmusto et al.	2015	The effect of pretreatment on the corrosion resistance of superheater materials

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
JP2011089974A	2011-04-14	2011-04-14	Thermal equipment structure

Applications Claiming Priority (1)

Application	Filing date	Title
JP2011089974A	2011-04-14	Thermal equipment structure

Legal Events

Date	Code	Title	Description
2014-01-10	A621	Written request for application examination	**Free format text**: JAPANESE INTERMEDIATE CODE: A621 **Effective date**: 20140109
2014-11-21	A977	Report on retrieval	**Free format text**: JAPANESE INTERMEDIATE CODE: A971007 **Effective date**: 20141120
2014-12-03	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20141202
2014-12-27	A521	Written amendment	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20141226
2015-05-26	TRDD	Decision of grant or rejection written	
2015-06-03	A01	Written decision to grant a patent or to grant a registration (utility model)	**Free format text**: JAPANESE INTERMEDIATE CODE: A01 **Effective date**: 20150602
2015-07-09	A61	First payment of annual fees (during grant procedure)	**Free format text**: JAPANESE INTERMEDIATE CODE: A61 **Effective date**: 20150701

2015-07-10	R151	Written notification of patent or utility model registration	**Ref document number**: 5774355 **Country of ref document**: JP **Free format text**: JAPANESE INTERMEDIATE CODE: R151

Concepts

machine-extracted

Download Filter table

Name	Image	Sections	Count	Query match
heat treatment		title,abstract,description	7	0.000
metal		claims,abstract,description	59	0.000
metal		claims,abstract,description	59	0.000
Chromium		claims, abstract, description	18	0.000
Chromium		claims, abstract, description	17	0.000
Chromium		claims, abstract, description	17	0.000
calcium		claims, abstract, description	13	0.000
calcium		claims, abstract, description	13	0.000
calcium		claims, abstract, description	13	0.000
potassium		claims, abstract, description	8	0.000
potassium		claims, abstract, description	8	0.000
potassium		claims, abstract, description	8	0.000
sodium		claims, abstract, description	8	0.000
sodium		claims, abstract, description	6	0.000
sodium		claims, abstract, description	6	0.000
magnesium		claims, abstract, description	Five	0.000

magnesium	claims, abstract, description	Five	0.000
magnesium	claims, abstract, description	Five	0.000
insulating material	claims, description	40	0.000
calcium monoxide	claims, description	16	0.000
nickel	claims, description	12	0.000
stainless steel	claims, description	12	0.000
stainless steel	claims, description	11	0.000
calcium oxide	claims, description	8	0.000
calcium;dioxido(oxo)silane	claims, description	8	0.000
composite material	claims, description	8	0.000
nickel	claims, description	6	0.000
insulation	claims, description	Four	0.000
iron	claims, description	Four	0.000
iron	claims, description	2	0.000
material	abstract, description	9	0.000
chemical reaction	abstract,description	7	0.000

Show all concepts from the description section