Vacuum Carburizing Furnace

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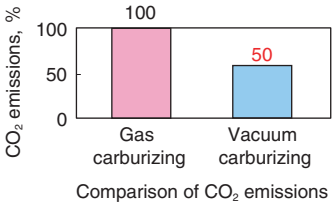
From the viewpoint of global environment protection, reduction of CO_2 emissions, an environmental loading substance, is required more and more, even from heat treatment furnaces. While vacuum carburizing furnaces have been drawing attention as the most promising heat treatment furnace for this purpose, significant improvements in energy cost needed for heat treatment have not been seen compared to conventional furnaces.

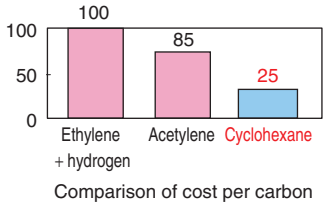
To solve this problem, KOYO TERMO SYSTEMS has developed a new vacuum carburizing furnace that uses cyclohexane as a carburizing gas. Introduced below is an outline of this furnace.

Main Specifications

Application	Carburizing and quenching
Effective dimensions	W 610×D 1 220×H 610
Max. charging mass	650 kg/charge
Heating source	SiC heater electrical resistance heating
Processing temperature	800～1 050℃
Carburizing gas	Cyclohexane



Comparison of CO_2 emissions

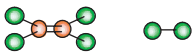


Comparison of cost per carbon

Comparison of each vacuum carburizing gas

<Conventional>

Ethylene (C_2H_4) + hydrogen (H_2)



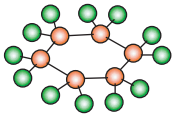
- Gas under room temperature
- Explosive range: 3.4 to 39.6 (volume %)
- Density: 1.260 kg/m^3 (gas)

Acetylene (C_2H_2)

- Gas under room temperature
- Explosive range: 2.5 to 100 (volume %)
- Density: 1.173 kg/m^3 (gas)

<Developed>

Cyclohexane (C_6H_{12})



- Liquid under room temperature
- Explosive range of: 1.3 to 8.0 (volume %)
- Density: 779 kg/m^3 (liquid)

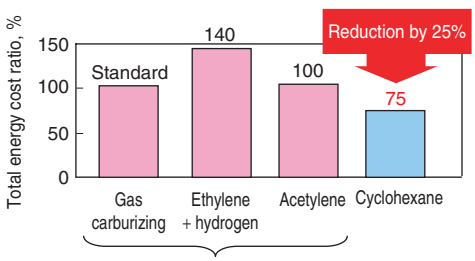
Element
C : Carbon
H : Hydrogen

- Compared with conventionally used vacuum carburizing gas, cyclohexane has the following merits ① low cost ② narrower explosive range, less risk of explosion ③ enables space saving at gas plant.
  However, gasification treatment is needed for it to be used as a carburizing gas as it is liquid under room temperature.
- As cyclohexane is used as a carburizing gas in the developed furnace, we have also developed technology for the stable introduction of gas into the furnace including gasification treatment.

Features

○ We achieved reduction of CO_2 emissions and cost in comparison to conventional furnaces.

- While conventional vacuum carburizing treatment can reduce shell loss compared with gas carburizing treatment, significant superiority in total energy cost including the cost of carburizing gas could not be found.
- Compared with gas carburizing treatment, the furnace that we developed can reduce the total energy cost by 25%, while maintaining the same quality as before.



Comparison of total energy cost

KOYO THERMO SYSTEMS CO., LTD.