High-pressure hydrogen gas trailer – Japan's first composite tank

Fuel cell vehicles (FCV)—hailed as the ultimate green vehicle—have recently been put on the market. To help keep hydrogen stations replenished with hydrogen needed to power these vehicles, Kawasaki developed a high-pressure hydrogen gas trailer for transporting, storing, and supplying hydrogen gas produced at hydrogen production plants including refineries.

The first of its kind in Japan, this trailer features a light-weight composite tank capable of easily storing high-pressure hydrogen. It is designed to ensure maximum security under emergency situations.

Preface

In response to the increasing popularization of fuel-cell vehicles, hydrogen stations are being established in various locations, leading to increased demand for more economical methods of transporting hydrogen gas produced at refineries and elsewhere to these stations and keeping and storing hydrogen tanks at the stations.

1 Objective

Hydrogen in its pure H2 state can be transported in either liquefied or high-pressure form. Liquefied hydrogen is suitable when transporting large quantities and high-pressure hydrogen when transporting small quantities. At the dawn of this new era for hydrogen-related business, companies do not yet expect great demand for large-scale

Table 1 Main specification of a hydrogen trailer equipped with a 45 MPa class composites tank

Item	Specifications
Trailer type	Flatbed semi-trailer
Axles and suspension	Dual-axle air suspension
Vehicle length and width (mm)	9,670 × 2,490
Hydrogen transport capacity (kg)	260
Keeping method	Ferry hook
Working pressure (MPa)	45
Gas type	Compressed hydrogen
Tank type	Type 3 composite tank
Tank capacity (L)	300
No. of tanks	24
Master valves	Manual valves with fusible-type safety valve
Top side	Opening/closing cover panels
Side	Punching metal doors
Front side	Door-type tank area access hatches
Rear side	Door-type control-station access hatches
Additional equipment	Fire extinguisher, gas detector

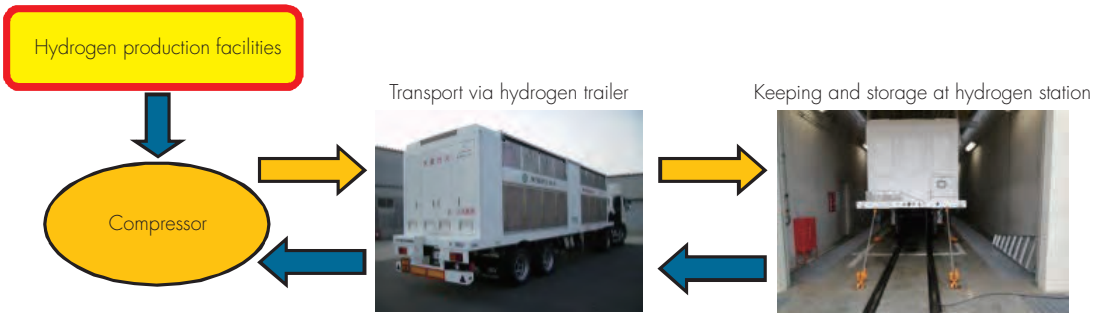

Fig. 1 Use in offsite hydrogen stations

distribution of hydrogen; rather, transport of high-pressure hydrogen is the predicted norm.

Until now, steel tanks loaded onto truck trailers have been used to transport high-pressure hydrogen gas. However, because it was necessary to cut costs in order to make hydrogen a feasible fuel source in our society, companies felt the need to reduce tank weights and enhance transport efficiency.

In FY 2011, the Kawasaki Group started by using composite hydrogen transport tanks and developing its 35 MPa class composite-tank hydrogen transport trailer based on the legally stipulated maximum of 35 MPa at the time. Later, in response to trends toward 45 MPa tank usage, the Group increased tank pressure further and upped capacity by two-and-a-half times, completing our 45 MPa class composite-tank hydrogen transport trailer.

2 Main specifications and operation

Table 1 provides an outline of main specifications for Kawasaki's 45 MPa class composite-tank hydrogen transport trailer.

There are two types of hydrogen stations: an onsite type wherein hydrogen gas or its base ingredients are collected
and high-pressure 40 MPa / 80 MPa hydrogen gas is produced, stored and supplied to vehicles, and an offsite type which does not include hydrogen production facilities. At offsite-type hydrogen stations, 45 MPa class composite-tank hydrogen transport trailers are utilized according to the process outlined in Fig. 1.

① The pressure level of hydrogen produced in hydrogen roduction facilities is increased to 45 MPa using a

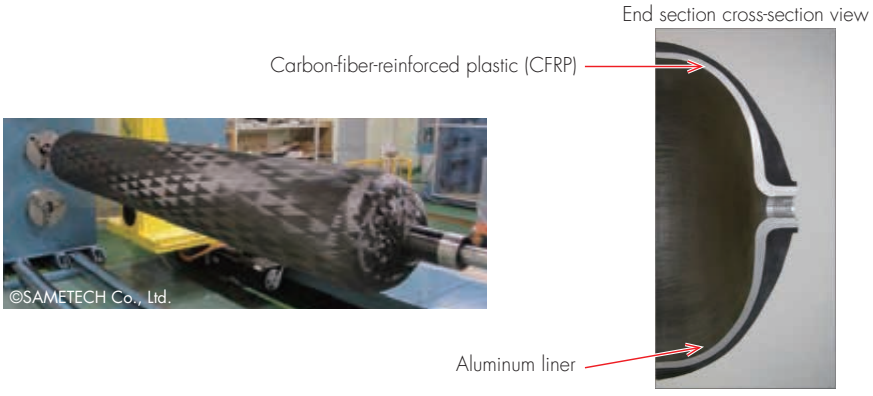

Fig. 2 Composite tank

compressor and transferred to composite hydrogen transport tanks.

② The hydrogen transport trailer is used to take this high-pressure hydrogen gas to the hydrogen station where the entire transport unit is kept and used as a storage/supply facility.

③ When the hydrogen pressure level becomes low, the tanks are taken back to the hydrogen production facility and refilled.

3 Unique product characteristics

(1) Composite tanks enable large-volume hydrogen transport

By making tanks from lightweight aluminum-alloy material wrapped with carbon-fiber-reinforced plastic (CFRP) boasting high tensile strength, we have achieved tank products that are lightweight yet also offer ultra-high pressure resistance (Fig. 2). Furthermore, the use of composite tanks makes it possible to haul more than

Fig. 3 Roof panels, side doors

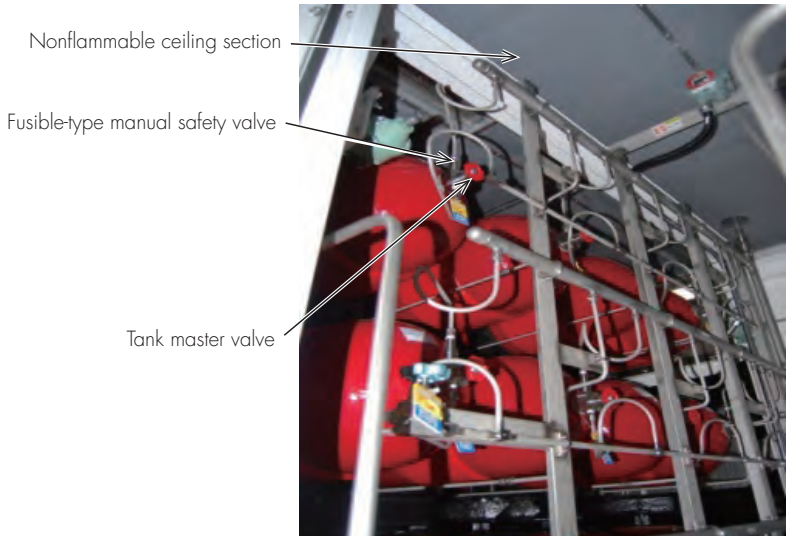

Fig. 4 Central tank master valve control room

approximately twice the amount of high-pressure hydrogen than would be possible with traditional steel tanks.

(2) Equipment and features to ensure trailer travel stability

Our trailers feature an electronic braking system (EBS) and air suspension to ensure stable road travel. Furthermore, our anti-lock braking system (ABS) offers the following features:

① Roll stability support (RSS), which detects potential rollovers and automatically activates the brakes to reduce danger
② Load sensing function to adjust braking strength in accordance with load size, and to prevent excessive braking strength when the trailer is empty
③ A function that records travel distance, trailer axle load and other vehicle information and displays it on a smart panel

(3) Structural design enhances safety and ease of operation (Figs. 3 and 4)

① Opening/closing roof panels can be operated with a lever to enable water spraying when high temperatures are detected
② Punching metal opening/closing doors are installed on the side surfaces to facilitate tank inspections and other such operations
③ Front-side access hatches are installed to provide access to the tank area
④ A central control station has been included to facilitate easy opening and closing of the 24 master valves for the tanks when they are being transported or are kept at a hydrogen station.
⑤ Fusible-type safety valves are used for the composite tank master valves to enable safe release of hydrogen should tank temperature become too high
⑥ Nonflammable material has been installed along the ceiling section in order to mitigate internal temperature spikes
⑦ An emergency shutdown valve in the rear-area control station automatically closes when temperatures reach or exceed 100°C (212°F)
⑧ A simple, one-step hose and coupler attachment for connection to hydrogen station supply piping are included in the rear-area control station

4 Commercial vehicle production

Currently, Kawasaki is developing a commercial-use hydrogen transport trailer capable of handling 1.4 times the capacity (34 tanks) of our existing 45 MPa class composite-tank hydrogen transport trailers. It will be shorter in length than the current model and usable at a wider range of hydrogen stations.

Postscript

Kawasaki was contracted research activities for this product by the New Energy and Industrial Technology Development Organization (NEDO), and it was developed in collaboration with Kawasaki Engineering Co., Ltd.

Moving forward, we predict that growing numbers of fuel-cell vehicles will lead to increased demand for our products, and in order to meet customer needs through safe and efficient transport of large quantities of hydrogen gas, we intend to improve ease of product operation while also reducing costs.

Kanji Maekawa

Contact information
Industrial Plant Division,
Kawasaki Engineering Co., Ltd.
Tel: +81-78-612-8585 Fax: +81-78-642-3654