THE LATEST NEWS NUMBER 261, 2017 FCDIC

New Energy Cars of Foreign and Local Firms Going Strong in China

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1. Governmental Measures

(1) Japanese Government

To promote fuel cell vehicles (FCVs) and hydrogen refueling stations, the Japanese government will launch an expert conference for reviewing related regulations this fiscal year. The council will pick up subjects regulated by more than a single ministry, and study mid- to long-term subjects which require amendments of laws with promoting and regulating parties in order to achieve a plan to increase to 40,000 FCVs and 160 locations of hydrogen refueling stations by FY2020. The regulatory reform plan which was approved by Cabinet meeting on June 9th picks up a total of 37 subjects related to FCVs to be revised, and states the government will start looking into necessary measures in FY2017. Any subjects needing mid- to long-term measures will be discussed in an open meeting with experts. In addition, the conference will have the High Pressure Gas Safety Office and the Hydrogen and Fuel Cells Strategy Office of the Ministry of Economy, Trade and Industry (METI) and business operators and industry related individuals as participants. Technological development is needed for the installation of hydrogen refueling stations, but it is also essential to revise stricter regulations in Japan than other countries. The government has already started gradual regulation reform for hydrogen refueling stations, and amending the regulations on installation has been completed. (The Denki Shimbun, June 20, 2017)

(2) MLIT

On June 30th, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) published a white paper on land, infrastructure and transport in Japan 2016. In the white paper, they suggest to use renewable energy as an anti-global warming measure in the energy area. Their suggestions are use of river water, a large infrastructure space including airports and offshore wind power generation in ports and steady and plenty biomass production at sewage treatment.to use potential of renewable energy. The white paper includes promotion of FCV use to realize hydrogen society, measures to commercialize fuel cell (FC) ships and to develop a marine transport system of liquid hydrogen. (The Denki Shimbun, July 5, 2017)

(3) China

China has kept the world's largest automobile market for eight years in a row. The result for 2016 was a double-digit growth with production of 28.12 million vehicles, 14.5% increase on that of the previous year, and 28.03 million sales, a 13.7% increase on that of the previous year. The world's largest market is formed for new energy cars led by electric vehicles (EVs) in China, and is still going strong there. Determining electrification as the key, foreign and local automakers brought new energy cars to Auto Shanghai in April. The new energy vehicle (NEV) program is expected to be implemented to force automakers to produce a certain ratio of eco cars, and local production of EVs is an entry ticket to the Chinese market. These are behind the movement. Promoting new energy cars further, the Chinese government compiled opinions for the Guidelines for Improving Management on Automobile Investment Projects on June 4th to shift its policy to stop investment going into conventional combustion engine cars such as gasoline and diesel cars. In the publication, plug-in hybrid electric vehicle (PHEV) will be classified as same as gasoline cars, while FCVs which previously were not mentioned much are to be managed in the same standard as EVs in the investment projects. FCV commercialization will be carried out for commercial use such as buses by local automakers. To go with this trend, more Chinese manufacturers have started to produce parts and components. (The Chemical Daily, July 10, 2017)

2. Local Governmental Measures

(1) Governor of Fukuoka Prefecture

On July 4th, the governor of Fukuoka Prefecture had a meeting with Parliamentary Vice-Minister of Economy, Trade and Industry, and requested support for promotion of renewable energy such as hydrogen and FC. The governor emphasized revising regulations for preparation of hydrogen

refueling stations to reduce operation costs of these stations. The Parliamentary Vice-Minister explained that 37 subjects related to hydrogen and FCs regulations were included in the regulatory reformation plan approved at the Cabinet meeting in June. The governor also asked for improvement of the Kanmon Interconnected Power System to send sufficient electricity including renewable energy to the Chugoku area. The Parliamentary Vice-Minister told the governor that the governmental target of energy mix is planned to be achieved by solving power grid limitation. (The Denki Shimbun, July 6, 2017)

(2) Niigata Prefecture

On June 21st, Niigata Prefecture held the first meeting in the prefecture of the committee to look into FCV promotion and preparation of hydrogen refueling stations. There is growing interest in FCV in Niigata Prefecture. However, the preparation of hydrogen refueling stations, a key of the promotion, is slower than the greater Tokyo and Chukyo areas, and actual measures urgently need to be carried out to promote FCVs. The committee will hold about five meeting in FY2017 to compile a vision for the promotion. The committee consists of 14 members including experts in the field and energy related organizations in the prefecture from industry, government and academia. Also, Toyota Motor and Honda participate in the committee. The prefecture has reported that it already has an import base of liquid natural gas (LNG) which gives the prefecture a higher potential for hydrogen energy promotion than other prefectures. (The Denki Shimbun, July 7, 2017)

(3) Hokkaido

On July 12th, Hokkaido held a delivery ceremony of FCV MIRAI as an official car in front of its former Hokkaido government office. This is the third FCV in Hokkaido after Muroran City and Shikaoi-cho. This FCV will be used by staff for prefectural operation and public relations to residents to promote hydrogen energy use. (The Chemical Daily, July 10, 2017; Nikkan Jidosha Shimbun, July 12, 2017)

(4) Kanagawa Prefecture

On July 12th, Toyota Motor and Kanagawa Prefecture announced that an evaluation project would be fully operational to develop a hydrogen supply chain on July 13th. In this project, hydrogen will be produced by wind power electricity to supply forklifts at plants and logistics bases. They estimate over 80% reduction in CO_2 emissions compared to normal forklifts, and will also evaluate the cost reduction effects. While growth of FCV and hydrogen refueling stations seems limited, they want to realize hydrogen society by developing a supply chain. This project is contracted from the Ministry of the Environment (MOE), and has been carried out with the cooperation of Toyota, Kanagawa Prefecture, Yokohama City, Kawasaki City, Toshiba and Iwatani. It started experimentally last November, and all the required facilities have been recently prepared. Toyota provided FC forklifts and a large capacity storage battery. Hydrogen production plant was prepared by Toshiba. Hydrogen storage tanks and transport vehicles were equipped by Iwatani. On July 12th, they had an open demonstration to the media of beer bottle carriers loading to a lorry at the Yokohama plant of Kirin Brewery Company. (The Sankei Shimbun, July 13, 2017)

3. FC Element Technology Development & Business Plans

(1) Dainichi

Dainichi produced ENE-FARM as contract manufacturing for JXTG Energy, but stopped this in 2015. However, the manufacturer has signed a contract to produce solid oxide fuel cells (SOFCs) of 3 kW which are developed by Kyocera, determining FC which is expected to grow in the future as its core business again. This system uses ceramic material which is Kyocera's specialty as a core material. Hydrogen extracted from natural gas and oxygen in the air chemically react to generate power through membranes combining about 50 ceramic plates in the system. For this FC production, Dainichi will use expertize and welding techniques gained from paraffin heater production. Also, the production line prepared for the FC production for JX Nippon Oil & Energy will be used for the new production. The manufacturer will automate existing production lines for paraffin heaters, and free up human resources by enhancing working efficiency to allocate people to FC production. (The Nikkei Business Daily, June 21, 2017)

(2) I'MSEP

I'MSEP, a venture from Doshisha University, has started joint research and development with material producers to use carbon coating for FC separators, lithium-ion batteries (LIB), and current collectors of capacitors. This coating uses molten salt electrochemical process as its base, and exhibits the same level of corrosion resistance to gold plating, and conductivity to that of graphite. The process has an advantage of reduced costs to a tenth of that of conventional coatings including pretreatment and associated processes, and the firm will commercialize the technology quickly as possible. KC1 or LiC1 is heated and liquefied to be a molten salt. The new carbon coating uses molten salt as a solvent, and calcium carbide is dissolved as a carbon ion source in the solvent to coat metal bases. When the metal base is connected to the anodic terminal of an external power source, electrons from the

carbide are attracted to the terminal and a neutral carbon film is deposited. The formed film has excellent corrosion resistance, high adhesion and low friction slidably. The materials to be coated with standard solutions are limited to 20 elements including gold and nickel. However, molten salts allow using over four times more materials to that of standard solutions. The promising application is FC separators, and the new process provides better resistance to acids compared to metal separators. The process advantageously allows giving the required corrosion resistance, is lightweight and gives mechanical strength to products as well as being a continuous production at the same as that of the standard coating. The firm's commercialization plan is to keep the technological development until the technology reaches a certain level, and then to provide the technology to businesses to further develop them for commercial products. (The Chemical Daily, June 26, 2017)

(3) IMS

Institute for Molecular Science (IMS) of the National Institutes of Natural Sciences (NIMS) has developed the world's first method to observe the behavior of catalysts of FC electrodes under an atmospheric pressure which previously required a vacuum. This method allows precisely observing reactions at catalysts of FC electrodes and seeing deterioration mechanisms under the atmospheric pressure in which a FC operates. IMS developed an X-ray photoelectron spectroscopy under atmospheric pressure using hard X-rays which contributes to highly functional FCs as a project of New Energy and Industrial Technology Development Organization (NEDO). X-ray photoelectron spectroscopy enables analyzing various materials at an atomic level, and is used for a wide range of electrode catalyst research. NEDO has set a target values for FCs by 2025, and carried out technological development of highly advanced analysis and evaluation since 2015. (The Chemical Daily, June 29, 2017)

(4) Kyoto University

On July 3rd, Kyoto University announced that FCs which directly use ammonia as fuel successfully generated 1 kW. This is joint research result in cooperation with Mitsui Chemicals, Nippon Shokubai, Noritake, IHI and Toyota Industries. Ammonia was directly supplied to the anodes of a SOFC cell stack of 30-single-cell lamination, and the stack succeeded to output power at the same level of general SOFCs. Direct current generation efficiency achieved over 50% of lower heating value (LHV), and the 1 kW level evaluation system carried out a continuous operation of 1,000 hours steadily. This result shows ammonia as a suitable fuel for SOFCs and possiblily to scale-up for commercialization of CO_2 free power generation.

Ammonia which contains a large amount of hydrogen is also expected to be used as fuel as well as potential energy carrier. The project also developed an autothermic reactor with a honeycomb catalyst which partially combusts mixed gas of ammonia and air. The autothermic reactor can start up quickly, and supplies the SOFC stack with mixed gas containing produced hydrogen. This system also succeeded at 1 kW level power generation. The team will develop a compact experimental package to generate 1 kW level. This power generation experiment was carried out at Kyoto University as a contract project of the Cross-ministerial Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation. (The Chemical Daily, July 4, 2017)

(5) The University of Electro-Communications

On July 5th, the University of Electro-Communications, announced that a system was developed to evaluate and analyze how FC catalysts work on a real-time basis using SPring 8, a large synchrotron radiation facility. The advantage of the system is an ability to measure the same spot of a single sample such as catalyst layer and electrolyte membrane at the same time using multiple methods such as X‐ray diffraction and X-ray absorption near edge structure (XAFS). Design guidelines of electrode catalysts, which have high reactivity, anddurability was difficult to know by a single method. Previously, samples were measured separately by different methods, and it was hard to find out reasons for different results. This development has been jointly carried out with Japan Synchrotron Radiation Research Institute (JASRI). (The Nikkei Business Daily, July 6, 2017)

4. Hydrogen Infrastructure Element Technology Development & Business Plans

(1) Toshiba

On June 20th, Toshiba announced that Tokyu Construction placed an order for H_2One, an independent power supply system using hydrogen energy. The system will be installed at the Institute of Technology of Tokyu Construction to start its operation in this fiscal year. In the system, photovoltaic generator generates electricity to electrolyze water for hydrogen production. Produced hydrogen is temporally stored, and FCs generate electricity as needed. Waste heat is used as a heat source for air conditioning of the building. The product has been used for business continuity planning (BCP), and this is the sixth project. This is the first to be used for renewable energy and energy saving of a building. Tokyu Construction

has already installed a photovoltaic generation system in the Institute of Technology. This time, Toshiba will deliver a container with hydrogen producer, hydrogen storage tank and pure hydrogen FCs inside. Tokyu Construction is converting the office building of the research center to be a model of net-zero energy building which produces energy to negate energy consumption. (The Denki Shimbun, June 21, 2017)

(2) Toshiba

Toshiba has developed a hydrogen sensor which achieves both quick detection and low-power consumption. The product uses its own micro electro mechanical system (MEMS) of palladium-based metallic glass. Without reducing speed, it detects hydrogen while cutting down power consumption to 1% of that of conventional products. The firm announced this at Transducers 2017, an international conference in Taiwan, on July 20. Conventional palladium hydrogen sensors take time for palladium to bond with hydrogen to form a compound, and use a large amount of power for the heater to release hydrogen. Toshiba uses palladium-based metallic glass which does not have a crystal structure. As the detection mechanism, the electrodes get closer due to membrane deformation, when the sensor membrane absorbs hydrogen. Because hydrogen does not form a compound in this system, hydrogen is released as hydrogen concentration decreases outside without heat. This significantly reduces power consumption. The new product can be produced at a semiconductor production line, and a number of sensors can be produced from a single wafer. The firm aims for commercial production from 2020. (The Denki Shimbun, July 22, 2017; Nikkan Jidosha Shimbun, July 13, 2017)

(3) Chino

Chino has developed a thermal conductive hydrogen sensor using MEMS, which overcomes issue of detection ability in a low concentration range while significantly increasing durability, in cooperation with Tohoku Gakuin. This product has a cantilever structure which uses a reduced amount of heat by MEMS, and detects hydrogen with a thermocouple temperature sensor which has an advantage for measuring temperature change and difference. Measurement of ±0.3% is achieved in the low concentration of 0 to 4% which is under the explosion limit of hydrogen gas. The firm uses its own humidity compensation technology to eliminate humidity effects to achieve an accurate measurement. (Dempa Shimbun, June 23, 2017)

(4) Asahi Kasei

Asahi Kasei has developed an electrolyser with the world's highest energy conversion rate and output. They aim to sell the product to supply industrial hydrogen produced using renewable energy to oil plants. An evaluation plant in Yokohama has operated since 2015, and achieved operation of over 9,500 hours. Safe commercial production of hydrogen was confirmed. The manufacturer achieved an energy conversion rate from electricity to hydrogen of 90% which is the world highest rate by using technology for reducing electrical resistance, catalysts and membrane separators to divide anode and cathode which were gained from its LIBs. Germany has been working on a plan to stop all of its nuclear power stations by 2022 and to cover electricity production with renewable energy. The firm aims for hydrogen production using over production of renewable energy, such as wind power which cannot to be sent to the grid, for desulfurization of crude oil and fuel for FCVs. German-based Siemens is leading in commercialization of hydrogen production system using water electrolysis, but Asahi Kasei plans to introduce a facility to output at the world's largest level of 10 MW as the first Japanese firm. As renewable energy use is increasing in Europe and Japan, the grid sometime cannot take all the renewable energy production. (The Nikkei, July 5, 2017)

(5) Takenaka Corporation

Takenaka Corporation has completed a product range of core technologies including energy management system (EMS) and hydrogen production and storage system which were developed for realizing low carbon society. Photovoltaic generator and storage battery, direct current power sources, are centrally managed for energy saving without stress, and power supply during disasters. The firm will offer these kinds of designs as projects to clients and developers who aim for low carbon society. In April, they signed a contract on a demand response program which gives discount on electricity in return for reducing electricity use on demand to a certain level for three hours with TEPCO Energy Partner. The subject of the contract is three buildings including Tokyo Head office in Koto-ku, Tokyo. Power generators, storage batteries and chargers for EVs which can also supply equipment with power are installed on the premises of buildings their group members use. Excess power production from photovoltaic generator is used for hydrogen production and storage, and FCs produce electricity and heat as needed. The construction firm started an evaluating operation of each facilities from June, and will install a storage tank of hydrogen storage alloy in December. Their aim is not to be an energy supplier, but they will propose projects as a constructor to clients and developers who are conscious of energy management and BCP. (The Denki Shimbun, July 13, 2017)

(6) Toshiba

On July 13th, Toshiba announced that the Hydrogen Application Center to supply FC forklifts with hydrogen produced by using renewable energy was open in its Fuchu Complex, and started the operation. The center was specifically designed to use locally produced energy. It uses H_2One, Toshiba's own independent power supply system using hydrogen energy. Electricity is produced by solar power to produce hydrogen, and hydrogen is supplied to FC forklifts on the premises. Hydrogen production of 5Nm^3/hr can supply four forklifts. This system can reduce costs of hydrogen transport due to production on site, and the firm aims for plants, warehouses, and airports. They target at a couple of hundred million yen for cost of the same class of the center in four to five years. (The Nikkan Kogyo Shimbun, July 14, 2017)

(7) The University of Tokyo & Tokyo Institute of Technology

Commercialization is getting closer for new technology to synthesize ammonia under moderate conditions near normal temperature and pressure. The University of Tokyo has developed a technology to efficiently synthesize ammonia from nitrogen under normal temperatures and pressures. Furthermore, Tokyo Institute of Technology has started development by jointly launching a venture with Ajinomoto aiming for commercialization.

By referring an ammonia production method of plants from nitrogen, the University of Tokyo cut down the process for the synthesis to half of that of previous similar research, and improved the synthesis efficiency by 10 times. The research has advanced to the level to start considering commercialization. The synthesis process was reduced by half by adding iodine to the existing catalyst which is made of molybdenum and nitrogen. Previously, a number of stages were needed to cut triple bond of nitrogen, but the new method directly cuts the bond to change the chemical to react with another material easier for the significant improvement of reactivity. By directly cutting the triple bond of nitrogen, a process to create unwanted hydrogen was eliminated. The team explains that this resulted in improved ammonia synthesis efficiency. Ammonia is produced at a level of about 170 Mt globally as a material for nitrogen fertilizer and gunpowder. Recently, it is expected to be used for storage and transport of hydrogen for FCs and energy areas such as as a direct combustion fuel. Now, ammonia plants operate in the severe conditions such as 500ºC and a couple of 100 times atmospheric pressure for the synthesis, and hydrogen production, a constituent of ammonia, also consumes a large amount energy. The synthesis method using a new catalyst works at normal temperatures and pressures, and does not require hydrogen as long as hydrogen ions are supplied. These allow saving huge energy for synthesis.

In addition, the Tokyo Institute of Technology developed a catalyst using electride which is a compound consisting of calcium oxide and aluminum oxide with ruthenium added, and aims for commercialization by 2021. This catalyst uses the property that the electride easily gives electrons away to other materials. This technology allows ammonia synthesis with nitrogen and hydrogen at a much milder conditions which is 300ºC and normal pressure than conventional methods. Furthermore, the team analyzed the mechanism of the catalyst, and also developed a catalysts using calcium amide which works over 10 times more efficient than conventional ruthenium catalysts. The team will research ammonia concentration technology using a separation membrane. Once technology is established for ammonia synthesis under near normal temperature and pressure, large-scale production will be available. Also, this allows on-site production to produce ammonia at a small-scale where the material is used as needed. (The Nikkei Business Daily, July 14, 2017)

5. ENE-FARM Business Plans

(1) Toshiba

On June 14th, Toshiba announced that the production and sales of ENE-FARM would finish at the end of July. Because their restructuring is underway to resuscitate the management, this business was selected for market withdrawal to focus on core businesses. At the moment, they are not considering closing the production plant or laying off employees. The production and sales are carried out by Toshiba Fuel Cell Power Systems, a 100% owned subsidiary. This subsidiary's ENE-FARM business has been in the red since FY2015, and they anticipate it will still be in the red for FY2016. Because their FC systems have been supplied to regional gas suppliers in Japan, they will keep maintenance service going irrespective of the withdrawal from the market. Also, the subsidiary's pure hydrogen FC systems will continue. In Japan, Panasonic and Aisin Seiki operate FC businesses. (The Nikkan Kogyo Shimbun, June 15, 2017)

(2) Tokyu Land Corporation

Tokyu Land Corporation and Tokyu Fudosan R&D Center have received certification from J-Credit for the effect on the reduction in CO_2 of the exclusively owned area of Branz Shinagawa Katsushima, a condominium. As J-Credit, the

Japanese government certifies effects of carbon capture such as forest management and reduction in greenhouse gases including installation of energy saving facilities. This is the first sole project of condominium certified in the scheme by installing ENE-FARM. An annual 94 t of CO_2 was reduced from October 2015 to September 2016, and this partially offset the emission from electricity consumption of the common areas of the condominium. The firms hope that offset certificates issued to residents will lead to raise consciousness about the environment. (Fuji Sankei Business i, July 5, 2017)

(3) Mitsubishi Jisho Residence

Mitsubishi Jisho Residence has released a new condominium range of the Parkhouse Oikosu. The design and construction will be carried out in cooperation with Haseko Corporation. This product range will use multiple advanced environmental technologies, and is designed into apartments to create next generation environment. As an advanced environmental technology, ENE-FARM will be installed in all the units to enable selling excess electricity back as a reduction in utility cost. The exclusively owned area of the units is between 67 to 96 m^2, and the number of rooms is a living, dining and kitchen area with storage room and two bedrooms to a living, dining and kitchen area and four bedrooms. The condominiums will be in Yashiro City of Saitama Prefecture, Sakai City of Osaka Prefecture and Kita-ku of Tokyo. (Jutaku Shimpo, July 4, 2047)

(4) Tokyo Gas

Tokyo Gas announced that its ENE-FARM would be installed at all the units of a new condominium in Yokoyama City. Tokyu Corporation along with others decided the installation of FCs for all 278 units of Dresser WISE Tama Plaza, the unit range from two to four bedrooms with living, dining and kitchen area, to start its sales next year. The FC system can be remotely controlled through Enepa, Tokyo Gas' app application for smartphones, and also has a function to continue power generation during power cuts. This new condominium with concept of high sustainability will be sold through Mitsubishi Corporation, Mitsubishi Jisho Residence and Obayashi-Shinseiwa Real Estate as well as Tokyu Corporation. The FC system allows an annual reduction of ¥40,000 of utility bills and 0.9 t of CO_2 compared to housing with conventional heaters. (The Denki Shimbun, July 5, 2017)

(5) Hokkaido Gas

On July 5th, Hokkaido Gas announced that it would sell home gas power generation system from August 1st. This system consists of a domestic gas engine and ENE-FARM, and can adjust its power output to fit with power shortages or excess through the grid. The accumulated sales target for this system is 3,600 units by the end of FY2017, and 9,000 units by the end of FY2020. The maximum power output is 1.5 kW, and thermal output is 3.7 kW. The power generation is 26%, LHV standard, and total efficiency is 90%. The price of the system is about ¥1.5 million depending on conditions. The function of independent operation during power cuts is optional. Surplus power production can be sold to the gas supplier, and the firm will use it for its electricity sales. The standard electricity purchase price is ¥13/kW, and will be adjusted by fuel costs. The firm expect to buy an annual 7,400 MW/h for FY2020. (The Denki Shimbun, July 6, 2017)

6. FCVs

(1) F Rent-A-Car

F Rent-A-Car, Naniwa-ku of Osaka City, has bought Toyota's FCV MIRAI and Prius PHV. These cars will go around the business areas of the branches to promote them and to be used for employees' training. The firm will investigate the possibility to hold a training session in cooperation with general insurance company. MIRAI will go to the Kansai area in July, to the Aichi area in August, and to the Kanto area in late August, and also visit business partners for a promotion. (Nikkan Jidosha Shimbun, July 3, 2017)

(2) JCCU

Japanese Consumers' Co-operative Union (JCCU), the operator of Co-op in Japan, has set a long-term environment vison to reduce CO_2 emissions by 90% of that of FY2013 by FY2050. Their delivery vehicles will be replaced with EVs and FCVs, and also their renewable energy development will be accelerated. The manufacturing industry is currently leading in setting long-term environment targets, but this JCCU's action is possibly going to become a model case for the distribution industry. (The Nikkei Business Daily, July 5, 2017)

(3) Teito Motor

On July 4th, Teito Motor started the first taxi operation in Tokyo using two of CLARITY FUEL CELL based in Omori Branch. By joining Honda's taxi project, Hino Kotsu and Omiya Jidousya already use FCVs, and Sendai Taxi will start FCV taxi operation soon. Taxi operation provides severe conditions for vehicles, and Honda will be given the driving data to improve its product further. (Nikkan Jidosha Shimbun, July 10, 2017)

7. FCV Component Development & Business Plan

(1) Hamai Industries

Hamai Industries produces valves for high pressure gas

containers and safety valves, and also has plenty of deliveries of parts for hydrogen dispensers for FCVs. They sell PISTOL GRIP of German-based WEH GAS Technology for hydrogen dispenser nozzle for refueling stations in Japan. Hamai Industries supplies their own safety valves for 70 MPa for FCVs. The product is designed to withstand up to 87.5 MPa and -40 to 85℃. They offer stainless steel and aluminum versions. They are developing stainless steel valves for ultra high pressure of 90.2 MPa for hydrogen refueling stations and for high pressure of 45 MPa for FCVs. (Fuji Sankei Business i, June 24, 2017)

8. Hydrogen Refueling Station Technology Development & Business Plans

(1) Orion Machinery

On June 27th, Orion Machinery announced that it developed a small heat exchanger for hydrogen refueling stations at a low cost as a joint project with academia. The price was reduced to over half of that of the initial product developed in 2014, and the weight was cut down by about 30% of that of product using the conventional method aiming to go into the market in November. Because hydrogen temperature increases as it is being sent to FCV at high pressure, it needs to be refrigerated to -40℃ beforehand. The developed product is a plate heat exchanger using layers of corrugated plates that the hydrogen and refrigerant circulate between to exchange heat. The manufacturer optimized the shape of flowing channels by fluid analysis to make flow and temperature distribution even. They improved heat exchanging performance and saved pressure loss to cut the size and number of plates down in order to reduce cost and weight. Low pressure diffusion bonding was developed to put heat transfer plates together to withstand 135 MPa. The development project was selected for the Strategic Foundational Technology Improvement Support Operation of METI, and carried out in cooperation with Shinshu University, National Institute of Technology, Nagano College and Nagano Prefecture General Industrial Technology Center. (The Nikkan Kogyo Shimbun, June 28, 2017)

(2) Kobe Steel

Kobe Steel will fortify the oversea sales operation of its compact heat exchanger for hydrogen refueling stations. They will build a relationship with firms which design and construct hydrogen refueling stations and facility manufacturers in Germany and France to look for potential users together. Kobe Steel's heat exchangers have higher heat transfer performance than conventional products, and the volume required for installation is reduced to a tenth. The firms will advertise these advantages to accelerate the pace of orders to an annual 30 units whereas the accumulated number of orders is currently 150 units. Stainless steel plates with 1 to 2 mm channels etched for hydrogen to go through are layered and bonded by diffusion bonding to be the compact heat exchanger. Nippon Yakin Kogyo supplies the stainless steel, which is specially designed to withstand the diffusion of hydrogen into the structure to make the steel brittle, to Kobe Steel to make the unit. This heat exchanger has five times the heat transfer area per unit volume of that of conventional double tube type heat exchangers, and can contribute to saving space and energy of stations. (The Nikkan Kogyo Shimbun, July 11, 2017)

(3) Iwatani

On July 10th, Iwatani announced that it would construct provisionally named Iwatani Hydrogen Station Okayamaminami, in Minami-ku, Okayama City in FY2017. The target users are owners of FCVs who live around the area and also FCV drivers travelling from a place with established hydrogen refueling station to another place to refuel on the way. This is to be the 23rd hydrogen refueling station for the firm. The total investment is a couple of ¥100 million. The site area is about 834 m^2. The facility will be stationary, and supply compressed hydrogen. The supply capacity is three FCVs per hour. The core component will be packaged to reduce space, which is to reduce cost for on-site construction. The station can increase storage capacity as the number of users goes up. (The Chemical Daily, July 12, 2017; The Nikkan Kogyo Shimbun, July 12, 2017)

(4) Tomoe Shokai

Tomoe Shokai has opened Shinsuna Hydrogen Station using an off-site production system in Koto-ku, Tokyo. Hydrogen is produced using plastic waste, which is the first project in Japan. Hydrogen is transported from Kawasaki City. This facility is the 13th hydrogen refueling station in Tokyo, and third in Koto-ku. Hydrogen is supplied to FCVs, FC buses and FCV MIRAI owned by Koto-ku. The station can supply six FCVs continuously. The total investment is just under ¥700 million. The operation started on July 3rd. The hydrogen price is ¥1,100/kg excluding tax. (The Denki Shimbun, July 11, 2017)

— Reported from June 14 to July 14, 2017 —