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Sewage Works as Hydrogen Power Plants

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1. Governmental Measures

(1) MOE

On March 19th, the Ministry of the Environment (MOE) showed its commitment to hydrogen energy development at a joint meeting of the "Environmental Working Group" and the "Environment and Global Warming Investigation Committees" of the Liberal Democratic Party of Japan. Hydrogen allows efficient energy usages such as fuel cells (FCs) and can be a storage method for renewable energy. These can lead to a significant reduction in CO_2 emissions. The ministry explained a plan for FY 2014 including an operational test of a large FC bus for public transport and a hydrogen production and storage experiment of wind power offshore from Goto Islands, Nagasaki Prefecture. However production, storage and transport of hydrogen require energy at each stage, which may not reduce CO_2 emissions. MOE pointed out that whole systems need to be evaluated for "hydrogen usage with reduced carbon emission". It is important for the mid- and long-term plan to aim for "CO_2 free hydrogen" combining with renewable energy or carbon dioxide capture and storage (CCS). (The Denki Shimbun, March 20, 2014)

(2) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will investigate the possibility of sewage works to be fuel cell vehicle (FCV) refueling stations. As new energy usage of sewage sludge and hydrogen supply infrastructure preparation, hydrogen production and supply technology at sewage works will be researched and tested. MLIT will seek low cost and efficient technologies to turn sewage works into FCV refueling stations as well as hydrogen reformation of sewage sludge. Expecting FCV market growth, the "Environmental Action Plan" to be drawn up by the ministry will include the hydrogen refueling function of sewage works as a usage of renewable energy using established infrastructure. Also local governments have already looked into biogas production from sewage sludge to fuel compressed natural gas vehicles, and have had experiments. These results and the knowledge will help the evaluation of the technologies to produce hydrogen from gas derived from biomass sludge at sewage works. To build a system, the ministry lists projects to evaluate hydrogen conversion efficiency and to test the effects of the gas components from sludge. (Nikkan Jidosha Shimbun, March 25, 2014)

To build a hydrogen society, MLIT will prepare a maritime transportation system of liquid hydrogen and standards for FCVs which uses technologies in the field of the ministry. For easier installation of hydrogen filling stations, deregulations of the Building Standards Act is intended. The ministry will soon start collecting public opinions. (The Denki Shimbun, Kanagawa Shimbun, The Kochi Shimbun & The Niigata Nippo, April 1, 2014)

The ministry started to invite subsidy applicants for operation of electric taxis and buses and for purchase, in an initial period, of micro mobility. Operation plans will be undertaken until May 9th and the operators will be chosen with third-party evaluation. Plug-in hybrid vehicle (PHV) and FCV are included in the subsidy schemes. (Nikkan Jidosha Shimbun, April 11, 2014)

(3) METI

Having reviewed the current technical standards, the Ministry of Economy, Trade and Industry (METI) raised the maximum filling pressure of gas container to transport hydrogen for FCVs from 35 MPa to 45 MPa on March 31th. This alteration allows tanker trucks to carry more compressed hydrogen at once, and improves transport efficiency. The Safety Regulations for Containers and the related notices based on the High Pressure Gas Safety Act were revised. The new regulation shows material standards for 45 MPa containers, and leakage test standards have become stricter. (The Nikkan Kogyo

Shimbun, Nikkan Jidosha Shimbun & The Chemical Daily, April 1; The Nikkei Business Daily, April 8, 2014)

(4) Japanese Government

On April 11th, the Japanese government approved at a cabinet meeting a new "Basic Energy Plan" which indicates guidelines for its mid- to long-term energy policy. The first plan was made in October, 2003, and this new plan is the fourth. Thorough energy saving, more encouragement of renewable energy usage and reformation of supply structure are included in the plan as shown in the initial draft. The structure of the secondary energy source which contribute to stable power supply and act against global warming will be reorganized. Technological development will be accelerated for ENE-FARM, FCV, and hydrogen production, storage and transportation as well as power generation from hydrogen. (The Denki Shimbun & The Chemical Daily, April 14, 2014)

2. Local Governmental Measures

(1) Kobe City

Kobe City has launched a committee to have a hydrogen filling station in the city in order to promote FCVs of which volume productions are expected to start in 2015. The first meeting will be held with Toyota Motor and Iwatani in June. The committee aims to decide the location for the hydrogen filling station and to complete the station in FY 2015. (The Nikkei Business Daily, March 27, 2014)

(2) Osaka Prefecture

Osaka Prefecture has a subsidy scheme to encourage businesses in the prefecture to research and develop new storage batteries, photovoltaic generators or FCs, and has increased the maximum subsidy amount to ¥10 million. The submission of applications started on April 11th. The scheme started in FY 2013 to subsidize up to ¥3 million. A number of firms requested raising the amount in order to operate larger experiments, and the amount has been tripled. The prefecture aims to support the battery industry to be able to compete more in the global market. The prefecture joins the "Kansai Innovation Comprehensive Global Strategic Special Zone" with Kyoto and Hyogo Prefectures, and supports the industry of new energy including batteries. (The Nikkei, April 12, 2014)

(3) Shunan City

On April 3rd, Shunan City announced that Iwatani's plan to prepare a liquid hydrogen filling station on city owned land was selected for METI's subsidy scheme. Iwatani will receive a maximum ¥260 million subsidy, and invest over ¥500 million with an aim of operation start in spring of 2015. For the filling station, Yamaguchi Liquid Hydrogen, Osaka City, was established in cooperation with Iwatani and Tokuyama (Shunan City), and will produce and provide liquid hydrogen to the station. (The Chugoku Shimbun & The Yamaguchi Shimbun, April 4, 2014; The Nikkei Business Daily, April 10, 2014)

(4) Okayama Prefecture

Okayama Prefecture will start a new project in this fiscal year to effectively use hydrogen and off-gases produced at petroleum refineries and petrochemical plants in Mizushima Complex. Having the special economic zone scheme in their mind, they will relax regulations and prepare financial support. The plants will be connected with pipes to provide gas, including hydrogen, as fuel. This efficient usage of energy is expected to lead to more competitive business for these plants. The prefecture plans to prepare the complex also as a hydrogen supply base for FCVs in future. (The Chemical Daily, April 10, 2014)

(5) Tochigi Prefecture & Matsumoto City of Nagano Prefecture

From 2015, Tochigi Prefecture and Matsumoto City, Nagano Prefecture will sell electricity generated by FCs at sewage works using the feed-in tariff scheme for renewable energy. Tochigi Prefecture plans to send electricity from three sewage treatments from March, 2015. These sewage treatments extract hydrogen from methane to generate electricity with FCs. Upper Kinugawa River Sewage Treatment Center and Uzumagawa River Sewage Treatment Center both have two units of FCs outputting 105kW. Matsumoto City will install a 300 kW FC system at Ryoshima Sewage Treatment Center. The trial operation will start in December, and the city plans to sell electricity from January, 2015. (The Nikkan Kogyo Shimbun, April 11, 2014)

3. FC Element Technology Developments

(1) Tokyo Institute of Technology

The research team of Assistant Prof. Kotaro Fujii and Prof. Masatomo Yashima at the Department of

Chemistry and Materials Science of Tokyo Institute of Technology has found an oxide of neodymium (Nd), barium (Ba) and indium (In) which is an ionic conductor with a new crystal structure. The material is $Nd_{0.9}Ba_{1.1}InO_4$ which was discovered while researching on the design structure of various elements and experimenting combinations. Equal amount of powdered Nd, Ba and In were mixed well, and the mixture was sintered at 1400°C with a pressure of one to two tons to make the oxide. The team confirmed the structure by observing with X-ray crystallography. In the crystal structure, InO_6 on which has negatively charged atoms are positioned at the top of an octahedron, Ba and Nd are regularly and stably arranged. According to the research group, yttria-stabilized zirconia (YSZ) which is known as an oxide ionic conductor has 0.1/cm Ω conductivity whereas the new material has 0.003/cmΩ at 850℃. "The new material has a low conductivity, but the conductivity may increase by single or double digits by partially changing an element as an improvement." says Assistant Prof. Fujii. (The Nikkan Kogyo Shimbun, March 18, 2014)

(2) Kyushu University

Associate Prof. Tsuyohiko Fujigaya and Prof. Naotoshi Nakashima at Faculty of Engineering, Department of Applied Chemistry of Kyushu University has developed a method to reduce the amount of platinum as FC catalyst. Platinum particles are fixed on surface of carbon nanotubes (CNTs) with a special resin. With the new method, particle size was made smaller and the distance between particles was adjusted in the process to optimize the reaction. Surface area of platinum increased per unit weight and the mass activity improved about eight times. The research group already developed a technology to fix and grow platinum particles on a CNT surface which is coated by the special resin. This technology was advanced by improving reactivity per mass in order to reduce the amount of platinum. The new method controlled particle size and density by adjusting the amount of platinum salts to be the platinum catalyst, when growing platinum on support. To compare, FCs were made with platinum particles of 1.2 nm diameter (4% by weight to CNT) and with platinum particles of 3.7 nm diameter (45% by weight) which is commonly used for catalyst. Because the FC with 1.2 nm diameter particles has a larger surface area per unit weight, it is activated and it reacted approximately eight times per mass more than the FC with 3.7 nm diameter particles. (The Nikkan Kogyo Shimbun, March 25, 2014; The Nikkei Business Daily, April 11, 2014)

The research group of Prof. Atsushi Takahara, a leader at International Institute for Carbon-Neutral Energy Research, and the University of Texas has developed a new adjusting method of organic-inorganic hybrid membranes. Inorganic nanosheets of alpha-zirconium phosphate was dispersed in a liquid and then injected in epoxy resins before curing. Resin film with inorganic nanosheets regularly layered was successfully created. The membrane characteristically has a high gas barrier function and transparency. The group will investigate applications of the product such as a fuel tank of cars and a coating material of FCs by using the forming ability of the high functional inorganic micro structure. (The Chemical Daily, April 10, 2014)

(3) JAIST

On March 25th, Associate Prof. Yuki Nagao at the School of Materials Science of Japan Advanced Institute of Science and Technology (JAIST) and Associate Prof. Shusaku Nagano at Nagoya University Venture Business Laboratory announced that a technology had been developed to improve the conductivity of hydrogen ion permeating membrane as a FC material. The chains of strongly-acidic polyimide molecules were orientated to be the membrane, and the membrane exhibited five times more hydrogen ion conductivity than Nafion®, a currently prevailing membrane. Drops of strongly-acidic polyimide solution went on a quartz substrate, and the substrate was spun at high speed to make the membrane with an orientated chain structure. In the performance test, the membrane demonstrated high hydrogen ion conductivity in a higher humidity; it outperformed Nafion® at 80% humidity and reached five times better conductivity in 96% humidity. (The Nikkan Kogyo Shimbun, March 26, 2014)

(4) Tohoku University

A group of Tohoku University observed the growth of metal oxides at an atomic level. A special microscope

and an equipment to make a thin film of oxide were combined for the observation of strontium titanate. The microscope allowed the team to distinguish titanium atoms from strontium atoms. While strontium titanate thin film was made on strontium titanate of the same composition, an arrangement of titanium emerged on the surface. The group observed this phenomenon. The combined facility allows the monitoring of surfaces and growth process of metal oxides at an atomic level to help find out mechanism of oxide growth. Metal oxides are promising materials for various usages including electrodes, and understanding formation of thin film will contribute to developments of FC or lithium-ion batteries (LIBs). (The Nikkei Business Daily, April 7, 2014)

4. MFC Development

The study group of Prof. Takayuki Hoshino at the Graduate School of Life and Environmental Sciences of University of Tsukuba has developed an on-site generator using organic matters in a bottom of a lake as a microbial fuel cell (MFC). MFC uses the organic metabolism of bacteria which can generate electricity, and electrons are collected from the bacteria at an electrode during oxidation decomposition of organic matters to create a current. These kinds of power generating bacteria are widely found in the environment. The group attached electrodes on top and bottom ends of a plastic mesh tube which is 50 cm long and 15 cm diameter to make the MFC. A used fishing net for shrimps was reused as the tube and cheap carbon fiber was chosen for the electrodes. The group also made electrode reaction more efficient. The output measurements show that the bacteria were very active from summer to autumn, and the MFC a created maximum of 0.4 mW. By storing power in a capacitor, the MFC lit a light emitting diode (LED). The experiment was carried out in Kasumigaura Lake. The group expects to light a LED without the capacitor by up-scaling and a series of cells. (The Nikkan Kogyo Shimbun, April 1, 2014)

5. ENE-FARM Development & Business Plans

(1) 3 Major Gas Suppliers

Tokyo Gas, Osaka Gas and Toho Gas, three major gas suppliers, have all increased their sales targets of ENE-FARM for FY 2014. Combined sales target of the three firms goes over 30,000 units which is 30% more than the target for FY 2013. Their sales activities will be accelerated to aim for an accumulate 1.4 million units by 2020 by adding cheaper models on to the range of high efficiently generation as well as cooperation with housing developers to sell the FCs for new houses. (The Nikkei Business Daily, March 18, 2014)

(2) Saibu Gas

On March 20th, Saibu Gas announced that three new ENE-FARM products would be released. Aisin Seiki's solid oxide fuel cell (SOFC) will sell for ¥2.15 million available from May 1st. Panasonic's polymer electrolyte membrane fuel cell (PEFC) and Toshiba FC System's PEFC will both sell for ¥1.95 million both available from April 1st. Saibu Gas largely increased its sales target from 1,270 units, the target for FY 2013, to 1,820 units for FY 2014. They will promote ENE-FARMs to house builders to increase the number of installation, and keep looking into products for apartment units. (The Denki Shimbun, March 24 & 28, 2014)

On April 11th, Saibu Gas announced that ENE-FARM for apartment units produced by Panasonic would be available from May 1st. The FC outputs 200 W to 750 W, and the hot water tank holds 147 L. With open price, the product for apartment units has improved airtightness to comply with the Fire Service Act, and its strong feet have better seismic performance. Airflow system is also improved to withstand strong winds. These improvements allow the FC system to be installed in a pipe shaft space of newly built apartments. (The Denki Shimbun, April 14, 2014)

(3) Keiyo Gas

Keiyo Gas, Ichikawa City, will provide repair service of ENE-FARM round the clock from April 1st. The repair service will be carried out by Keiyojusetsu, a group member. Spending about a year for preparation, the firm has sent its engineers to the manufacturers such as Toshiba for training courses and qualification, because repairing ENE-FARM requires special skills. (Chiba Nippo, March 27, 2014)

(4) Daiwa House

Daiwa House joins in an energy project of Shizuoka City and is preparing a group of "smart houses" in the city which are equipped with photovoltaic generators,

FCs and a system to manage generation amount. The development was selected as the first "Smart House Promotion Model Area", a new project of the city for FY 2013. The firm will promote a group of smart houses which are still uncommon in Sizuoka Prefecture. (The Shizuoka Shimbun, March 29, 2014)

(5) Osaka Gas

Osaka Gas will release new ENE-FARM type-S on April 1st. This product will sell for ¥2.322 million which is approximately ¥0.63 million cheaper than the existing model. Annual ¥92,000 utility saving is expected for an average household. (Jomo Shimbun, March 31, 2014)

(6) Hiroshima Gas

Hiroshima Gas will sell ENE-FARM for apartment units, with a sales target of 520 units, a 70% increase. (The Chugoku Shimbun, April 3, 2014; The Denki Shimbun & The Nikkan Kogyo Shimbun, April 4, 2014)

(7) Hankyu Realty

Hankyu Realty will sell apartment units equipped with FCs in Kobe City. "ENE-FARM type-S" will be installed in each unit, and allows a saving 80% electricity purchase for a household of three each year as well as 20% reduction in CO_2 emission comparing to a conventional apartment unit. Its self-sustained function keeps the generation during power cuts including disasters. The construction of the apartment will start in May and the completion is expected by September, 2015. The total number of units is 204. (The Nikkei Business Daily, April 8, 2014)

6. Cutting Edge Technologies FCVs & EVs

(1) AIST

A team of the National Institute of Advanced Industrial Science and Technology (AIST) has developed a technology to reduce hydrogen leakage of FCV fuel tank using clay which is produced largely in the Tohoku area. The team covered inside a resin tank with thin clay-based film, and confirmed that escaping hydrogen was reduced by 90%. The team led by Takeo Ebina, the team chairperson, of AIST Tohoku discovered an aspect of a special clay-based film to cut down the amount of hydrogen escaping. To make the film, "bentonite" which is used for molds to cast iron is mixed in water and formed in a shape. The film has approximately 50,000 layers of 1 nm, and its microscopic crystals prevent hydrogen passing through. With Kyushu Institute of Technology and a private firm, AIST Tohoku tested a resin tank internally covered with clay-based film. In 20 days, the hydrogen escape amount was a tenth that of a tank without the film. With improvements with local firms, AIST Tohoku plans to bring out the technology as a new business for the damaged area by the Great East Japan Earthquake. (The Nikkei, March 17, 2014)

(2) Toyota

On March 20th, Toyota Motor announced that user experience survey of a single-seater three wheeler EV "i-ROAD" would be carried out in the Greater Tokyo area including Tokyo and Kanagawa Prefecture. This experimental survey will use 10 EVs, and each participant will use one without restriction for about two weeks. The firm will investigate how the vehicles are used for further development. (The Nikkei, March 21, 2014)

Toyota Motor will build a system which allows the production of 1,000 FCVs each year at the Honsha Plant in Toyota City. A sedan type FCV will be released in 2015 in Japan, the US and Europe. The firm aims for under ¥10 million for the price, and plans to increase the production level to an annual couple of 10,000 vehicles by 2020. Their FCV are being tested on public roads to improve safety and reliability. (The Nikkei, March 26, 2014)

(3) Honda

On March 25th, Honda Motor announced that its FCV "FCX Clarity" would be provided to Saitama City, Kanagawa Prefecture and Osaka Prefecture for free. The FCVs which can supply appliances with power will be used as official cars and for various events as well as an emergency power source during disasters. The firm will collect data from actual driving and power supply to external appliances for research, development, mass production and promotion of FCVs. FCX Clarity can provide an average household with power for approximately six days. (Nikkan Jidosha Shimbun & The Nikkan Kogyo Shimbun, March 26, 2014; The Chemical Daily, March 28, 2014)

Honda Motor plans to produce annual 1,000 FCVs from November, 2015 to sell in Japan, the US and Europe. A five-seater sedan FCV is under development, and planned to be sold for less than ¥10

million in Japan. Its tank will use carbon fiber to withstand high pressure to store fuel to drive approximately 500 km on a full tank. Honda's Sayama Plant in Sayama City, Saitama Prefecture, efficiently produces various cars including sedans and minivans, and has been chosen as the best option for the FCV assembly to reduce the production cost. (The Nikkei, March 26, 2014)

(4) Kintetsu & Nara Prefecture

Kintetsu Corporation, a railway operator, and Nara Prefecture have prepared a system to send power from a solar power plant in Oyodo Town in the prefecture through EVs during disasters. From May, they will investigate how much electricity the system can provide to the town community center which can accommodate approximately 160 people during disasters. The solar power plant built by Kintetsu Corporation outputs 3,000 kW, and electricity is stored in storage batteries. In an emergency, Nissan's EV "Leaf" is charged to carry the power to the community center. The community center will be equipped with a facility to receive electricity from the car. Kintetsu Corporation plans to prepare the same system in housing developments around the area in future. (The Nikkei, March 26, 2014)

(5) Daikin & Kansai University, Nippon Kodoshi & AIST

Daikin and Nippon Kodoshi have individually developed technologies to improve heat resistance of LIB for EVs. High heat resistance eliminates the need for a device to cool down the LIB, which reduces the power consumption and weight of an EV. This will extend driving range by 30 to 40% on a single charge, and also prevent batteries catching fire, which improves safety. Current LIBs do not perform fully at over 45°C and potentially catch fire. To prevent these, chillers are installed in EVs. Chillers operate fully at high air temperatures during summers, and this shortens driving range by 30%. Because LIBs' temperature goes up nearly 60°C without chillers, automakers aims for over 60°C for the heat resistance of LIBs. To achieve this, all key components such as an electrolyte, electrodes and separators need to withstand the heat. In collaboration with Kansai University, Daikin has developed a highly heat resistant electrolyte and electrode. Because an electrolyte easily catches fire, they replaced the material of the electrolyte with fluorine and confirmed that the electrolyte operates at 60 °C without problems. Glue to fix metal materials of the electrode was changed to avoid the glue melting at high temperatures as an improvement. On the other hand, Nippon Kodoshi cooperated with AIST, and improved the heat resistance of the electrodes and separator. The separator uses processed plant fiber, and does not shrink like current resin films at high temperatures. This keeps performance. They also changed to highly heat resistant glue for electrodes. (The Nikkei, March 28, 2014)

(6) BMW

On April 3rd, Germany-based BMW's affiliate in Japan revealed an EV in six colors. The EV uses carbon fiber for the first time for the vehicle body as a mass production model in order to reduce the weight, and drives 229 km on a full charge. The price is ¥4.99 million, and the governmental subsidy of ¥400,000 is available. Already 13,000 people have booked for a test drive. (The Nikkei, April 4, 2014)

(7) Panasonic

The subsidiary in Germany of Panasonic has developed a cheaper charger system for EVs in cooperation with "ubitricity", and plans to release the system in Europe by 2015. The system charges power from street lights, and will sell for approximately ¥100,000 per unit excluding installation, a tenth that of a conventional charger. The system uses Panasonic's combination of LED and a technology to control brightness depending on traffic volume and ubitricity's billing system. Energy is saved by replacing existing street lights with LEDs and controlling LEDs. Saved energy will be used for the charger system. Converting street lights allows easily increasing the number of chargers. Europe is accelerating preparation of infrastructure for EVs; for example, London aims to install 25,000 chargers. Panasonic has determined the automobile as a growth field, and is speeding up enhancement of its charger business for EVs. (The Nikkei, April 4, 2014)

(8) Yodogawa Works

Yodogawa Works, a metal processing firm in Osaka Prefecture, has started talks with local chamber of commerce and smaller businesses to jointly develop an open-top EV this year. The decoration design will be chosen from young people's ideas, and local small

businesses will build an EV with their technologies. Their roofed three-seater EV is displayed at an EV cafe "Meguru" opened in October 2013. The driving range is 50 km and it can go up a slope. The new one will be used for on- and off-site transport for visitors at events. (The Nikkei, April 7, 2014)

(9) Hyundai Automotive

South Korean-based Hyundai Automotive applied a project to the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) which is a public private partnership under the EU Commission, and has got 75 FCVs to deliver. Sport utility vehicle "Tucson" (ix35 or JM) based FCVs will be exported. (The Nikkei, April 8, 2014)

(10) VW

On April 9th, a major luxury vehicle producer Audi, a German-based Volkswagen (VW) group member, announced its partnership with FAW Group of China for PHV production and sales. They intend to start the PHV production at a joint base with FAW Group by 2016 to sell the vehicles to urban areas such as Beijing and Shanghai. Audi plans to also produce core components including the battery and control system in China. A sedan PHV "A6 L e-tron" will be jointly made at a joint plant of VW and FAW Group in Changchun, Jilin. The PHV can be charged through a domestic wall socket and drives 50 km only on its motor. (The Nikkei, April 10, 2014)

(11) Toyota, Nissan, Mitsubishi & Honda

Toyota Motor, Nissan Motor, Mitsubishi Motors and Honda Motor together will establish a new venture to speed up the preparation of charging infrastructure in Japan to promote EVs and PHVs. The venture plans to launch by the end of May with even investments among four firms, and to consider also FCV infrastructure in the future. The four automakers have been cooperating for charger infrastructure preparation since last July, and aim at 4,000 quick chargers and 8,000 normal chargers to be installed. The venture aims to start installation by the end of this year, and is expected to increase the targets. Installation cost is up to ¥5 million per quick charger, and approximately ¥30 billion is required to achieve these targets. However, the governmental subsidy scheme can support up to two thirds of charger installation costs. The rest of the cost will be divided by the four firms. With the state subsidy, filling stations and convenience stores may be able to install chargers for free. (The Nikkei, April 12, 2014)

(12) Toyota Industries

Toyota Industries plans to develop a next generation FC forklift by 2018. FCs which are under development for Toyota Motor's new FCV will be provided to make a FC unit for the forklift. Currently the second generation of prototype FC forklift in use costs a couple of ¥10 million to produce. However the next generation aims at several million yen by using cheaper parts except for the cells. (Nikkan Jidosha Shimbun, April 12, 2014)

7. Hydrogen Filling Station Technologies and Business Plans

(1) Iwatani & JX Energy

Iwatani and JX Nippon Oil & Energy will start hydrogen filling station preparation for FCVs this summer as the earliest. Iwatani will build four commercial hydrogen filling stations in Japan, and JX Energy will open 10 stations mostly in the Kanto area. JX Energy plans to combine hydrogen facilities with gasoline filling stations, and prepare 40 stations in places including Saitama Prefecture and Hachioji City, Tokyo, by 2015. Toyota Tsusho will build hydrogen filling stations in Nagoya and Toyota Cities in cooperation with Air Liquide Japan. Tokyo Gas will install hydrogen filling facilities to natural gas filling stations in Saitama City and Nerima-ku, Tokyo. Hydrogen filling facilities are estimated to cost approximately ¥600 million to install. METI aims to bring down the cost to the same level in Europe, around ¥300 million. To achieve this, regulations will be eased to reduce the cost and to support facility installations. (The Nikkei, March 26, 2014)

(2) Osaka Gas

On April 2nd, Osaka Gas announced that a hydrogen filling station "Kitaosaka Hydrogen Station (provisional)" would be built to operate commercially in Ibaraki City, Osaka Prefecture. The filling facility will be installed in a natural gas filling station operated by Osaka Gas. Hydrogen will be extracted by a generator "HYSERVE-300" developed by Osaka Gas from natural gas fed by pipeline. The facility can fully fill a FCV in approximately three minutes. The hydrogen supply performance is 300 Nm^3/h, and the production level is six vehicle worth in an hour. The

station can ship hydrogen to other hydrogen filling stations which are not equipped with hydrogen production facilities. The investment is ¥500 to 600 million. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Sankei Shimbun, The Denki Shimbun, The Nikkan Kogyo Shimbun & The Kobe Shimbun, April 3, 2014; The Kyoto Shimbun, April 4, 2014)

(3) Toho Gas

On April 2nd, Toho Gas announced that a hydrogen filling facility "Nisshin Hydrogen Station (provisional)" would be added in an existing filling station "Nisshin Eco Station" supplying gasoline, natural gas and liquefied natural gas (LNG) in Nisshin City, Aichi Prefecture. The construction will start in May, and the hydrogen filling facility is planned to operate in the first half of FY 2015. Having adopted an off-site production system, the filling station will not be equipped with a hydrogen production facility, and hydrogen will be delivered from a refinery. The hydrogen supply ability is 300m³/h. (The Denki Shimbun & The Chunichi Shimbun, April 3, 2014)

8. Hydrogen Production/Refining Technology Developments and Business Plans

(1) Kyushu University, Fukuoka City & Others

On April 4th, Fukuoka City, Kyushu University, Toyota Tsusho and Mitsubishi Kakoki announced that an experiment of technology to produce hydrogen from sludge of sewage works as a fuel for FCVs. This technology plans to be commercialized in two years as an effective usage of sludge which is largely produced in urban areas. The experiment will be carried out at a sewage works in Fukuoka City until the end of 2015. Hydrogen production is 3700 m³/day which can fully fill 70 FCVs. (The Nikkei, The Nishinippon Shimbun, The Ibaraki Shimbun, The Nagasaki Shimbun, Oita Godo Shimbun, Okinawa Times & Akita Sakigake Shimpo; April 5, 2014; Japan Metal Daily, April 7, 2014; The Nikkan Kogyo Shimbun & The Chemical Daily, April 8, 2014)

(2) Mitsui Chemicals

Mitsui Chemicals will advance its development of bio hydrogen production technology. With Japan Blue Energy (JBEC), they have formed a research group, and carried out an experimental production of bio hydrogen from sewage sludge. As the next step, empirical research is under consideration in a regional city. Cost efficiency is expected to be researched in collaboration with a local government of a 200,000 population level. The firm targets to supply FCVs and stationary FCs with hydrogen. (The Chemical Daily, April 10, 2014)

9. Measuring Device Development & Business Plan

Full-Tech, Osaka Prefecture, has developed a hand-held micro vacuum furnace. The new product is an advancement of the small electrical furnace available from November, 2013. With an electrical furnace, only oxides can be tested, but a vacuum furnace has an extended range of samples to test by being able to examine reduction processes. The new product will sell for between ¥400,000 and 500,000 from March 20th. Expecting an annual 1,000 units of sales, the manufacturer aims to change its core business from industrial purposes to the development of research devices by having a presence in the field of evaluation devices. The dimensions of the micro vacuum furnace are 120 mm wide, 330 mm deep and 300 mm high with a weight of 4 kg. There are two choices for internal dimensions; 26 mm diameter and 50 mm deep or 45 mm diameter and 60 mm deep. The electricity consumption is 800 W, and it takes three minutes to reach the maximum temperature of 1,200°C. Vacuum furnaces are essential for FC electrodes and materials for photovoltaic generators, and can provide sample tests which cannot be done with electrical furnaces. (The Nikkan Kogyo Shimbun, March 27, 2014)

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