sciendo DOI 10.2478/ntpe-2020-0002

2020
Volume 3
Issue 1
pp. 9-20

Production of Hydrogen from Coke Oven Gas in JSW Group

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Date of submission to the Editor: 02/2020
Date of acceptance by the Editor: 03/2020

INTRODUCTION

Jastrzębska Spółka Węglowa is the largest producer of coking coal in the European Union and one of the leading producers of coke, an essential component for steel production, without which it is difficult to imagine the development of an innovative economy. The JSW Capital Group (JSW Group) from a traditional supplier of strategic raw material for the steel industry is becoming a model company of the industry with a value chain:

Coking coal – coke – gas – hydrogen – clean and environmentally friendly energy; which will allow the development of new regional competencies and the evolution of the traditionally mining region into a modern, environmentally friendly technological centre – an industrial centre of the 21st century. The decision on potential investment in hydrogen production will also allow the JSW Group to expand its current product offer.

One of the effects of the transformation of the global economy into a modern low-carbon industry is the growing demand for environmentally friendly products, such as electric cars or wind power plants (JSW.pl, 2020).

The purpose of the publication is to analyse the possibility of producing hydrogen from coke oven gas obtained in the JSW Group using the pressure swing adsorption (PSA) technology under Polish conditions (corresponding to the current market demand for this energy medium without the negative impact of the hydrogen separation installation on the technological processes taking place in coking plants, related to coke oven battery firing, operation of existing power units, gas compression systems and taking into account the securing of external consumers' needs for coke oven gas.

The studied technology of hydrogen separation from coke oven gas is widely used in industrial gas separation processes, however, due to the composition of coke oven gas, which apart from hydrogen (ca. 55-57% by volume) and methane consists of impurities in the form of hydrocarbons, sulphur compounds, chlorine, etc., it needs to be adapted to the needs of hydrogen separation from coke oven gas. The composition of coke oven gas requires that a typical PSA installation be retrofitted with additional equipment to remove from the gas those

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impurities which may have a harmful effect on the PSA process; additionally, it is necessary to use specially selected qualified adsorbents and design the system so as to ensure high purity of hydrogen meeting the requirements for fuel cell applications. The most important element of the analysed project is the production of hydrogen for applications in emission-free transport, which, according to the EU policy, is to be a tool in the fight against carbon dioxide emissions from this sector (Więcław-Solny I. et al., 2019).
Hydrogen has been proclaimed the fuel of the future several times over the last decades; there has already been talk of the hydrogen society, but then the focus was on its properties and potential, with no backing from any prepared and mature technologies for its use as a fuel. The intense development of fuel cells, the scale of their production and the methods of their implementation in automobiles, railway vehicles, marine propulsion systems, systems of dispersed generation of electricity and heat, makes hydrogen as the fuel of the future no longer a slogan but a real chance to be used in these solutions. Hydrogen used so far mainly in the refinery sector and fertilizer plants has now a chance to play a very important role in low-emission transport, and thus become the main tool in the fight against smog, especially in large cities (Więcław-Solny I. et al., 2019).
This publication does not cover financial analysis.

HYDROGEN AS A FUEL

The product of the hydrogen - coke oven gas separation plant is hydrogen of the purity class required for use in Fuel Cell Electric Vehicles (FCEV). The purity requirements for hydrogen and the maximum permissible degree of impurities produced by the analysed hydrogen separation system are in accordance with ISO 14678 – 2:2012 and SAE J-2719, for a fuel cell with proton exchange membrane (PEM FC), Table 1 (M. Ohi J. et al., 2016).

Table 1 Hydrogen purity standards according to ISO 14687-2: 2012

Characteristics (assay)	**Type I, Type II**
	Grade D
Hydrogen fuel index (minimum mole fraction) [a]	99.97%
Total non-hydrogen gases 300 μmol/mol	300 μmol/mol
Maximum concentration of individual contaminants	
Water (H_2O)	5 μmol/mol
Total hydrocarbons (Methane basis) [b]	2 μmol/mol
Oxygen (O_2)	5 μmol/mol
Helium (He)	300 μmol/mol
Total Nitrogen (N_2) and Argon (Ar) [b]	100 μmol/mol
Carbon dioxide (CO_2)	2 μmol/mol
Carbon monoxide (CO)	0.2 μmol/mol
Total sulphur compounds [c] (H_2S basis)	0.004 μmol/mol
Formaldehyde (HCHO)	0.01 μmol/mol
Formic acid (HCOOH)	0.2 μmol/mol
Ammonia (NH_3)	0.1 μmol/mol
Total halogenated compounds [d] (Halogenate ion basis)	0.05 μmol/mol
Maximum particulates concentration	1 mg/kg

NOTE: For the constituents that are additive, such as total hydrocarbons and total sulphur compounds, the sum of the constituents are to be less than or equal to the acceptable limit. The tolerances in the applicable gas testing method are to be the tolerance of the acceptable limit.

[a] The hydrogen fuel index is determined by subtracting the "total non-hydrogen gases" in this table, expressed in mole percent, from 100 mole percent.

[b] Total hydrocarbons include oxygenated organic species. Total hydrocarbons are measured on a carbon basis (μmolC/mol). Total hydrocarbons may exceed 2 μmol/mol due only to the presence of methane, in which case the summation of methane, nitrogen, and argon is not to exceed 100 ppm.

[c] As a minimum, includes H_2S, COS, CS_2 and mercaptans, which are typically found in natural gas.

[d] Includes, for example, hydrogen bromide (HBr), hydrogen chloride (HCl), chlorine (Cl_2), and organic halides (R-X).

Hydrogen is a clean and pollution-free fuel – energy carrier; and can be used to power fuel cells. The energy generated by the cell is transferred to the engine through an inverter, controller, etc. The engine drives the propulsion system and drive axle. Compared to conventional cars, the energy conversion efficiency of fuel cell vehicles is as high as 60-80%, i.e. 2-3 times higher than in internal combustion engines. The fuel cell uses hydrogen and oxygen as fuel and produces clean water. No carbon monoxide, carbon dioxide, sulphur or particulates are emitted in the process. Therefore, hydrogen fuel cell vehicles achieve zero emissions and are fully environmentally friendly.

The technology for separating hydrogen from coke oven gas is fully mature and is particularly economical compared to the production of hydrogen by water electrolysis.

HYDROGEN PRODUCTION CAPACITY IN JSW GROUP

Coke and Chemical Projects Division Team from JSW Innowacje S.A., in consultation with the JSW S.A. Group's Coking Plants, determined the limit values for hydrogen production in PSA technology at the Przyjaźń, Jadwiga and Radlin Coking Plants, without the negative impact of the separation installation on technological processes associated with coke oven battery firing, operation of the existing power units, gas compression systems and taking into account securing the needs of external customers for coke oven gas.

The coking plants of the JSW S.A. Group produce approx. 1,626,293,512 m^3 of coke oven gas annually (production figures for 2018) – 1,210,872,590 m^3 at Przyjaźń Coking Plant, 331,240,419 m^3 at Radlin Coking Plant and 104,180,503 m^3 at Jadwiga Coking Plant. This volume of coke oven gas contains approximately 905,000 $m^{3,}$ or 74,000 Mg of hydrogen. Approximately 47% of coke oven gas (including hydrogen) is directed to technological processes (firing of the coke oven battery). Approximately 27% is directed to power engineering needs (for Przyjaźń Coking Plant this includes its own needs consuming approximately 37% of the produced gas), the remaining part of the gas being sold to external recipients or wasted – it is burned on technological flares (approximately 5%). Therefore, coke oven gas at the JSW S.A. Group's coking plants is consumed practically in full and the process of its utilization is presented in Figure 1.

Fig. 1 Utilization of coke oven gas produced in the coking plants of the JSW Group

The hydrogen – coke oven gas separation installation will enable the separation of most of hydrogen from coke oven gas. This process output is high-purity hydrogen as well as methane gas (its composition, apart from methane, also includes residual hydrogen and other combustible gases) with a higher calorific value compared to coke oven gas before separation. This is due to the fact that the calorific value of hydrogen is Q = 10 MJ/m^3 and reduces the calorific value of coke oven gas. It is true, however, that coke oven gas carries the most energy per unit of mass Q = 120 MJ/kg – this is due to its low density d = 0.082 kg/m^3. Thus, the separated amount of gas (hydrogen) does not significantly reduce the total energy supplied in the gas (for technology or energy needs). However, it is important to maintain appropriate calorific values of gas for the coke oven battery and power units (design assumptions for these installations). The above description is illustrated in Figure 2.

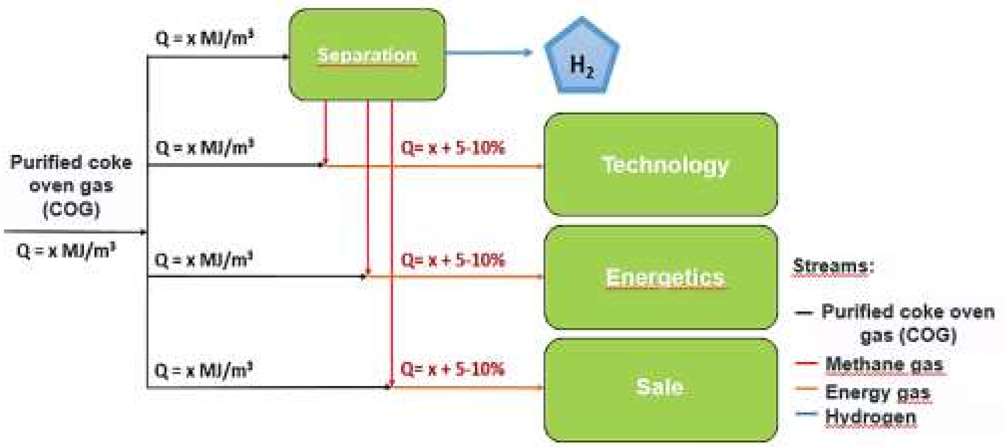

Fig. 2 Scheme for the management of gases resulting from the separation of hydrogen from coke oven gas

According to analyses for Przyjaźń Coking Plant, the maximum possible level of hydrogen production, which does not cause the necessity of interfering in the currently operating technological systems, is 14.09 thousand m^3/h hydrogen (1156.0 kg/h hydrogen, assuming 8400 operating hours of the installation per year, annual production capacity will amount to 9,710 Mg) obtained from the separation of 30 thousand m^3/h of coke oven gas. As a result of the hydrogen separation, methane gas will be produced at the same time (having a significant share of methane in its composition) in the amount of about 16.46 thousand m^3/h with the calorific value of about 21.54 MJ/m^3. The resulting methane gas is mixed with a stream of coke oven gas (directed for technological and energy needs), changing its calorific value to 17.41 MJ/m^3 (approx. 5% of the calorific value of coke oven gas).

At the Jadwiga Coking Plant, it is possible to produce hydrogen from the separation of up to 8 thousand m^3/h of coke oven gas in the amount of 3.58 thousand m^3/h of hydrogen (293.6 kg/h hydrogen, annually 2,348 Mg). As a result of the hydrogen separation, methane gas in the amount of about 4.39 thousand m^3/h is produced simultaneously, with the calorific value of about 24.28 MJ/m^3. The resulting methane gas in the amount of approx. 1.5 thousand m^3/h is mixed with a stream of coke oven gas, directed for technological needs, changing its calorific value to 19.8 MJ/m^3 (approx. 8% of the calorific value of coke oven gas). The remaining methane gas can be sold or directed for power engineering purposes in case of constructing an internal power unit.

At the Radlin Coking Plant, it is possible to produce hydrogen from the separation of approximately 11,000 m^3/h of coke oven gas in the amount of 4,600 m^3/h hydrogen (380 kg/h hydrogen, annually 3,040 Mg). As a result of the hydrogen separation, methane gas in the amount of about 6.06 thousand m^3/h is produced simultaneously, with a calorific value of approx. 23.27 MJ/m^3. The resulting methane gas in the amount of approx. 2.9 thousand m^3/h is mixed with a stream of coke oven gas, directed for technological needs, changing its calorific value to 18.7 MJ/m^3 (approx. 6% of the calorific value of coke oven gas). The remaining methane gas combined with coke oven gas can be sold or directed for power engineering purposes in case of constructing an internal power unit.

The total hydrogen production capacity at the JSW S.A. Group's Coking Plants based on the separation of coke oven gas without the negative impact of this technology on the operation of the existing technological infrastructure is approximately 15,098 Mg per year.

HYDROGEN PROJECT CHARACTERISTICS

Identification and availability of technological solutions for installations

Coke-oven gas is a gas with a high hydrogen content (approx. 55-57% by volume), so for its acquisition it is necessary to apply an appropriate separation technique; see Tables 2, 3 (Więcław-Solny I. et al., 2019).

Table 2 Coke oven gas composition

Compound	Coke oven gas	
	% vol.	Nm^3/h
Ar	0.0993	1.94
O_2	0.2959	5.77
N_2	8.6490	168.66
CO	5.6224	109.64
CO_2	2.2958	44.77
CH_4	22.2958	434.77
C_2H_6	0.9275	18.09
C_2H_4	1.8251	35.59
C_2H_2	0.0516	1.01
C_3H_8	0.0705	1.37
C_3H_6	0.1698	3.31
H_2O	0.7000	13.65
Total	100.00	1,950.00

Table 3 Coke oven gas impurities

Compound	H_2S	Naphthalene	Tar	Benzene	Organic sulphur	NH_3	HCN	Toluene	Xylene	Total
Content mg/Nm^3	134-224	17-21	6-27	42-47	122-149	6-8	6-10	44-64	57	434

In industrial practice, the following are used for the treatment or separation of gas streams:

• Physical and chemical absorption processes,
• Adsorption processes,
• Membrane processes (Jun Shen et al., 2007),
• Cryogenic processes.

The most extensive application in the processes of separation and purification of hydrogen-bearing gases is found in adsorption technologies, especially the Pressure Swing Adsorption (PSA) method.

The process of pressure swing adsorption is based on the phenomenon of selective gas adsorption on solid adsorbents. The driving force of the process is the difference in pressures in successive cycles of adsorption (running at increased pressure) and desorption (running at reduced pressure). The process of pressure swing adsorption consists in such a selection of process conditions and type of adsorbent that one of the components of the gas mixture is selectively adsorbed on the bed. Then, after the adsorbent bed is saturated, the pressure is reduced in order to desorb the component. Technologies based on the process of pressure swing adsorption are nowadays a commonly used solution in installations producing hydrogen from natural gas, for the process of separating carbon dioxide from hydrogen. PSA systems are increasingly used to produce oxygen and nitrogen from air, replacing cryogenic methods. Pressure swing adsorption installations are characterized by low investment and maintenance outlays and low failure rates. They can be quickly started up and shut down. They are flexible in terms of load. They are slow to decapitalize. The installations are basically operated at ambient temperature and do not require any thermal insulation investments (Moyseowicz A. et al., 2015).

The separation of hydrogen from purified coke oven gas was developed by the Japanese Nippon Steel corporation (Nippon Steel Techn. Rep., 2005). Already in the beginning of the 21st century, a 99.999% vol. pure hydrogen production plant for the automotive industry was launched there (production capacity of 200 kg/day). The process was based on the Brayton helium cycle (20-23°K). Liquid hydrogen at -250°C was obtained. The processed coke oven gas came from a coking plant where a mixture of coal and waste plastics was used as raw material. The coking of such mixtures allows to enrich coke oven gas with hydrogen (Nomura S. et al., 2003, Heino J.et al., 2013). The experience gained during the operation of the demonstration plant was used to build an industrial plant with a production capacity of 6200 million m^3/year (under normal conditions). This process was carried out in Japan on an industrial scale, supplementing the technological scheme with a catalytic reforming node contained in hydrocarbon gas (Ni/MgO) (Zhibin Yang et al., 2010).

The PSA adsorption methods applied to coke oven gas are combined with appropriate methods of coke oven gas purification from dust, tar and polymerizing substances, naphthalene, benzol, water, HCN, H_2S and organic sulphur compounds. The removal of these impurities is necessary due to their negative impact on the sorption capacity of the highly efficient adsorbents used in PSA. A separate problem is the removal of oxygen and unsaturated hydrocarbons from the gas. Oxygen is difficult to separate from hydrogen in the PSA process and unsaturated hydrocarbons tend to be polymerized, especially when using zeolite molecular sieves (Budner Z. et al., 1989).

Description of the selected technology

Due to the fact that coke oven gas has a relatively complex composition and contains many different impurities, and the hydrogen produced must meet the standard for fuel cells, the installation involves eight processes:

1) Process for removing higher hydrocarbons

Coke oven gas is part of a higher hydrocarbon removal system consisting of two adsorbers removing higher hydrocarbons, which also remove most tar and naphthalene. The adsorbent is disposable and does not require regeneration. Saturated adsorbent is replaced by new one.

2) Desulphurization process

In order to remove H_2S from the coke oven gas, a desulphurization system consisting of two units is used. When the sulphur content is high, the two units can also operate in series.

3) Pre-treatment process

To ensure sufficiently long adsorbent working time in the subsequent PSA processes, the coke oven gas is pre-treated. This process consists of two adsorbers to remove water, benzene, toluene, xylene and other impurities. When the adsorber is regenerated, heated desorbed gas is used to desorb the adsorbed naphthalene and hydrocarbons. For final blowing, a desorbed gas of normal temperature is used, which simultaneously cools the instrument.

4) PSA process

The PSA system consists of five adsorbers and other auxiliary equipment. The adsorption process takes place in several adsorbers at a time, while the other adsorbers are in different stages of regeneration. The adsorber, after the adsorption phase, recovers the adsorbed gas through multistage expansion (decompression phase). The adsorbed gas is fed into the pre-treatment system and sent out as fuel gas.

Depending on the composition of the feed gas and the variation in feed gas intensity, the system can automatically adjust the adsorption time to ensure the correct hydrogen quality and increase production efficiency.

5) Deep desulphurization process

The sulphur content of hydrogen leaving the PSA system is extremely low. However, in order to ensure a stable product quality over a long period of time, hydrogen is subjected to desulphurization. Desulphurization takes place using a dedicated adsorbent, a desulphurization agent.

6) Deoxidation process

After desulphurization, hydrogen is fed to the refiner, a reactor, where traces of oxygen in the gas are removed by a catalytic reaction in the unit – reducing the oxygen content in the gas.

7) Drying process

For the drying of the gaseous product, drying under constantpressure is applied.

8) Hydrogen compression process

The hydrogen produced from the buffer tank may be fed to other systems or to a hydrogen compressor that compresses hydrogen to 20.0 MPa. The compressed hydrogen may be fed to a hydrogen tanker or a temporary storage facility.

A block diagram is shown in Figure 3.

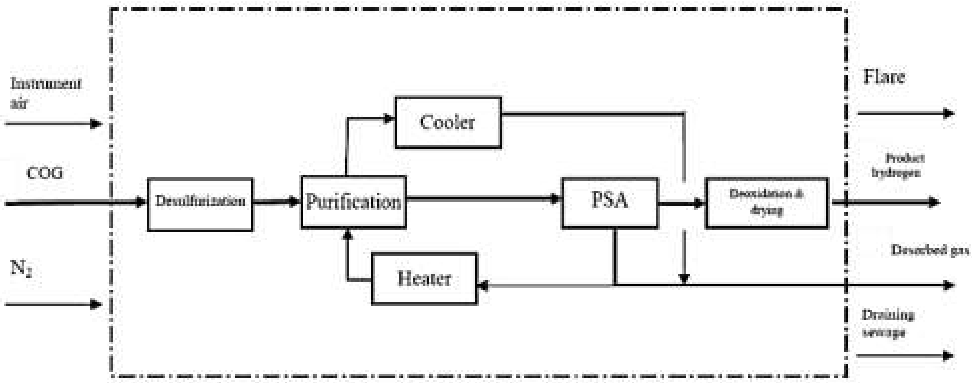

Fig. 3 Hydrogen separation installation from coke oven gas – block diagram

HYDROGEN MARKET PROSPECTS

Hydrogen for automotive applications requires an appropriate structure, therefore the estimated development of the infrastructure was analysed to assess the market prospects for hydrogen. The assumptions for investment in hydrogen refuelling stations are based on corporate announcements by 2030, according to which charging stations are distributed proportionally to the number of FCEV (Fuel Cell Electric Vehicles). This is based on the assumption that an average FCEV consumes 0.5 kg of hydrogen per day, so a station with a hydrogen capacity of 200 kg/day is capable of handling about 400 FCEVs. Similar to fast chargers, a gradual penetration of larger stations is assumed: stations with a capacity of 500 kg/day will dominate the refuelling structure in 2035, but after 2040, stations with a capacity of 1,000 kg/day will start to dominate. According to the authors of the report (Cambridge Econometrics Cambridge and Brussels, 2018), the number of electric vehicles on the roads is estimated at 17 million in 2030, and 170 million in 2050. In 2030 the share of FCEVs will be 2%, which will have practically no macro-economic impact on the transport sector and the demand for hydrogen. The analysis of the provisions of strategic documents concerning electromobility in Poland showed that hydrogen is mentioned as an alternative to traditional fuels. At the same time, the document (Ministry of Energy, Journal of Laws 2018, item 317), adopted by the Council of Ministers in March 2017, presents the position that there are no grounds for the development of hydrogen fuel stations in Poland in the coming years.

Such an approach indicates a lack of government support for refuelling structures in Poland, which will result in a lack of development of the FCEV car market. This means that in the coming years the produced hydrogen will not find a market in the car segment. Therefore, it is pointed out that there are possibilities to sell the produced hydrogen in the segment of truck and bus transport, the condition of sale being to find a recipient - a public transport company, municipal transport enterprise, and to sign an agreement on hydrogen supply. However, it should be stressed that the number of vehicles in such a case will be very limited due to their high cost, hence the demand for hydrogen in this segment would be negligible compared to the supply of hydrogen produced in an installation of the JSW Group. According to data presented in 2018 by Solaris Bus, the share of hydrogen buses in the European market was estimated at 2, 5 and 9% in 2020, 2025 and 2030 respectively. The cost of purchasing a 12-meter hydrogen powered bus, with basic specifications, is approximately EUR 750 thousand (Więcław-Solny I. et al., 2019).

In terms of the need to reduce CO_2 emissions from power sector units, it is possible to establish cooperation with an energy company in the supply of hydrogen for the purpose of utilizing CO_2 through chemical synthesis of e.g. synthetic methane, so-called SNG.

Hydrogen can also be mixed in small quantities with natural gas and injected into the existing gas network, but it is important to remember the administrative and technical limitations of this process that determine the permissible fraction of hydrogen added. The level of hydrogen that can be safely injected into the gas network depends on the distribution system and terminal equipment, due to the different nature of hydrogen and methane combustion, a high hydrogen

content may have a negative impact on the gas equipment used (Staffell I. et al., 2019).
The analysis of possible sales markets for the hydrogen produced by the JSW Group, for the current state of development of the hydrogen market and the existing demand for hydrogen, shows that there is a realistic possibility of selling hydrogen produced in the pilot installation variant (a few to several dozen kg H_2/h) to such customers as Air Liquide, Messer, who have expressed interest in purchasing hydrogen for their own commercial activities. On the basis of the information obtained, supply of limited quantities of hydrogen is possible (for Air Liquide it is about 100 thousand m^3/year, i.e. 8.2 Mg/year in cylinders and bundles and about 2500 thousand m^3/year, i.e. 205 Mg/year in trailers); the other companies Messer and Linde did not send any quantitative information, but Messer confirmed its interest in purchasing hydrogen. In a conducted interview, a representative of Messer declared comparable amount of demand for hydrogen for own needs (Więcław-Solny l. et al., 2019).
At the present stage of development of the hydrogen market, for the large scale variant, i.e. 1156 kg H_2/h, there is a real market for the sale of hydrogen for the CCU technology, therefore potential recipients of hydrogen will be all energy groups, especially those which have their production capacity in Silesia, so they will not have to bear high transport costs. In addition, with good supply logistics, there is also the possibility of minimizing hydrogen storage costs throughout the whole CCU manufacturing chain.

HYDROGEN PROJECT GEOGRAPHICAL AND ENVIRONMENTAL ASPECTS

As a result of the analyses and findings, the Project Team appointed to implement the hydrogen project in the JSW Group proposed that the most advantageous location for the construction of the installation for separating hydrogen from coke oven gas will be Przyjaźń Coking Plant.
When considering the location of Przyjaźń Coking Plant in terms of hydrogen production for low-emission transport, its very good location should be emphasized. The plant is located in one of the most densely populated areas in Poland. Silesia is an industrialized area of the country, with rich traditions and work culture. It is also an area with highly developed road infrastructure, which should be of particular importance in relation to the market of recipients of fuel - high purity hydrogen.
Numerous scientific centres are located in this area, including, among others, renowned technical universities which guarantee the possibility of obtaining highly qualified technical staff for the purposes of employment in the plant producing hydrogen from coke oven gas.
The location of the Przyjaźń coking plant near the Motorway and expressways and the related infrastructure (fuel stations) will generate in the future demand for hydrogen to drive electric cars with fuel cells (FCEV), ensuring demand for this type of fuel.

In addition, the location of the plant near the refuelling stations will reduce the costs associated with the transport of hydrogen, which should have a positive impact
on the price of the offered hydrogen and the competitiveness of the fuel on the manufacturers' market. Currently, consultations are being held between the distribution system operators and entities managing traveller service points over the locations of hydrogen filling stations.
According to General National Road and Motorway Directorate's figures, the distance from the nearest planned hydrogen filling station (Sosnowiec MOP II – Shell Fuel Station on road S1) is 10.5 km in a straight line and 14 km from the investment site at Przyjaźń Coking Plant (Więcław-Solny I. et al., 2019).

CONCLUSIONS

This publication has proven that the JSW Group has a nationally significant hydrogen production potential (15,098 Mg per annum) obtained from coke oven gas and that the proposed PSA technology for its recovery from coke oven gas is best recognized and optimal to market expectations for high-purity hydrogen for use in Fuel Cell Electric Vehicles.
Based on the obtained analyses of the hydrogen market, as well as known difficulties in maintaining stable parameters of coke oven gas, it is recommended to build a pilot installation. The constructed installation should be treated as a research facility, mainly due to the need to build a market, adapt the parameters of the installation to the variable parameters of coke oven gas, and build competence in the JSW Group in the production and sale of high-purity hydrogen. The implementation of the research project in the investment formula will allow the JSW Group to operate more freely and reduce the risk associated with adapting the technology to the parameters of coke oven gas produced at the Group's coking plants.
The pilot character of the installation will allow the Principal to enter the market quickly, establish business links and take advantage of the favourable price situation for hydrogen offered on the market.

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Abstract.
The publication analyses the possibility of separating hydrogen from coke oven gas for further use in the transport sector in the FCEV segment (fuel cell electric vehicles). The construction of the separation installation using the PSA (pressure swing adsorption) method guaranteeing high purity of hydrogen was assumed, according to the requirements of ISO 14678-2:2012 and SAE J-2719 standards. The PSA technology is widely used in industrial gas separation processes, however, due to the composition of coal gas, which apart from hydrogen and methane consists of impurities in the form of hydrocarbons, sulphur compounds, chlorine, etc., it needs to be adapted to the needs of separation of hydrogen from coke oven gas. The study shows the total possible hydrogen production potential and then, in agreement with the JSW Group's Coking Plants, limits were set for hydrogen production in PSA technology at Przyjaźń, Jadwiga and Radlin Coking Plants, without the negative impact of the separation installation on technological processes associated with coke oven battery firing, operation of existing power units, gas compression systems and taking into account securing the needs of external customers for coke oven gas. Additionally, in order to determine the Polish market demand for high-purity hydrogen, an analysis was carried out which indicates that in 2030 the share of FCEVs will be 2%, so the demand for hydrogen in this segment would be negligible compared to the supply of hydrogen produced in a large-scale installation. Due to the need to build such a market and adapt the parameters of the installation to the variable parameters of coke oven gas, the pilot scale of the installation and the target location of the installation at the Przyjaźń Coking Plant were indicated as the most optimal.

Keywords: Hydrogen, Coke oven gas, Fuel Cell Electric Vehicles, Pressure swing adsorption