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RENEWABLE GAS PRODUCTION PROJECT FINAL REPORT

GAZBİR-GAZMER

cleangas TÜRKİYE

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ABSTRACT

The studies of mixing hydrogen with natural gas at certain rates continue in many countries in the EU, in Japan, in the USA, and in many countries of the world. Many countries have begun to revise their policies, strategies, and projections after 2030 in order to reduce carbon emissions by mixing hydrogen with natural gas, enrich natural gas with hydrogen, and add value to natural gas.

Within the scope of R&D funds of the Energy Market Regulatory Authority, Turkey took its place in the developing hydrogen works in the world with the Renewable Gas Production project together with AKSA and ENERYA companies in July 2019. GAZBIR-GAZMER worked with great devotion in the whole process from the installation stage to the testing stages together with the project team, and did their best for the successful conclusion of the project. At the beginning of 2020, installation works of the Clean Energy Technologies Center was initialized in Konya.

With the Renewable Gas Production project, Power to Gas studies were started in Turkey. Hydrogen was produced via electrolysis of water by using electrical energy obtained from renewable energy sources in the laboratory environment. Combustion tests were carried out in domestic burning devices by mixing the produced hydrogen with natural gas at different rates (5-10-15-20%). As a result of the tests conducted, the consumption amounts, loss/leakage, heating value, Wobbe index, flareback, and CO emissions were observed.

Tests for mixing hydrogen with natural gas were completed in July 2021. After the tests were completed, tests were carried out on the equipment and devices in order to see the effect of the natural gas-hydrogen mixture on the equipment and devices used in the laboratory.

In this study, the results of the combustion tests of natural gas hydrogen mixed gas at different rates in domestic appliances and the results of the material tests of the equipment and devices used after the tests were reported at our Clean Energy Technologies Center in Konya. As a result of the tests, it was seen that there is no obstacle to the use of natural gas-hydrogen mixture in natural gas lines. Depending on the natural gas hydrogen injection studies, the infrastructure was created for pilot zone studies on the use of hydrogen in natural gas systems and domestic appliances in Turkey.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Global warming and climate change have become very important in daily life, especially in the last 10 years. States, non-governmental organizations and social organizations recognize the importance of achieving the energy transition for development, socio-economic stability, and reduction of carbon emissions. Currently, the United Nations (UN) has announced that 66 countries have committed to reducing their carbon emissions to zero by 2050 as part of the struggle with climate change.

With the Paris Climate Agreement, 28 Member States of the EU aim to keep global warming well below 2 °C, which is above pre-industrial levels, and even to limit the temperature increase to 1.5 °C. Decarbonisation technologies play a critical role in achieving this goal of the EU. Thus, especially hydrogen will be needed more than ever. Hydrogen, on the other hand, can be used not only as a means of decarbonisation, but also as a means of energy storage and transmission. Thus, the scope of regenerative power can be increased [2].

The fuel of the heat given by the sun and other stars to the thermonuclear reaction is hydrogen and it is the main energy source of the universe. Hydrogen was discovered in the 1500s, its flammability feature was recognized in the 1700s, and it is the simplest and most abundant element in the universe, accounting for an estimated 75% of the entire mass in the universe, as the first and lightest atomic element formed after the Big Bang [1].

Since hydrogen and electricity are types of energy that can be easily converted to each other, it is predicted that hydrogen will become more important day by day in terms of affecting all the sectors directly or indirectly and determining the level of social development and welfare. Hydrogen has the capacity to play an important role in providing heat, transport, and power system services alongside electricity in a low carbon economy. Since hydrogen, which is a secondary energy source, can be obtained with renewable primary energy sources, it is inevitable that it will be the most important energy carrier of the future. Hydrogen technologies, especially fuel cells, provide a stabilizing, controllable capacity as a solution to the problem of intermittent renewable energy sources. In addition to managing short-term dynamics, converting electricity to hydrogen or other fuels can provide long-term storage.

Gasification of electricity is a key area of interest for decarbonisation and increased flexibility in energy systems because it makes it possible to absorb renewable electricity when the supply is high, and to provide backup energy when the demand is high.

Another advantage is that gas emissions from the gas network can be reduced by injecting a low-carbon gas into the gas network (e.g. hydrogen from the process of converting electrical energy produced by renewable energy into gas) [3]. Thus, it is understood that the integration of hydrogen with natural gas will make significant contributions to the transition to decarbonisation. In addition, when compared to the electricity grid, the natural gas infrastructure can transport larger volumes over longer distances at less cost. The reduction in the use of natural gas in most decarbonisation studies in Europe indicates that gas infrastructure needs have subsequently decreased [4].

Evaluation of the potential of use of hydrogen in our country, as in the world, continues with small-scale projects and political discussions. In the workshop on Energy Exploration Meetings: Hydrogen held at the Ministry of Energy and Natural Resources in 2020; in the speech of Mr. Fatih Dönmez, Minister of Energy and Natural Resources of the Republic of Turkey, stated that “It is aimed to have the first hydrogen entry into the distribution lines by the end of 2021 at the latest”. Accordingly, at the beginning of 2020, Turkey's first Power to Gas project started in Konya within the scope of R&D projects of the Energy Market Regulatory Authority (EMRA), under the management of GAZBİR-GAZMER, in cooperation with Aksa Natural Gas, Enerya Natural Gas subsidiary and Yıldız Technical University. Minister of MENR, Mr. Fatih Dönmez stated that “Within the scope of this project, very important developments are taking place in our country, and very valuable studies are being carried out. At first, this project may be experimental and a very small amount, but the important thing is that the system works successfully.” and he put forward an important goal regarding hydrogen. This project work aims to bring our country to an advantageous position in global energy competition with technologies that make natural gas more environmentally friendly by injecting hydrogen into existing gas networks.

Figure 1.1: Outside view of the Clean Energy Technologies Center.

Although natural gas is the least harmful fossil fuel, hydrogen appears as a new solution that will contribute to the decarbonization efforts with its environmental impacts further reduced. Clean Energy Technologies Center was established in Konya by GAZBİR-GAZMER in order to work with different sources in the field of energy. In the relevant center, besides the Renewable Gas Production project studies, studies on renewable and low-carbon gas technologies are also carried out. Within the scope of the project, hydrogen is produced via electrolysis method of water using renewable energy sources. This method provides green hydrogen production with zero carbon emissions. By integrating electricity into gas and integrating it into the natural gas network, it is possible to take advantage of the structural volume flexibility of the network and transfer some of the electricity variability to the gas network [2]. It is therefore not surprising that hydrogen is thought to play a prominent role in the energy system of the future.