Natural gas knowledge

What is it

Natural gas is a fossil fuel like oil and coal. It is a mixture of hydrocarbons, mostly methane, and other gaseous substances such as carbon dioxide, nitrogen, hydrogen sulphide and, in some cases, helium. The mixtures that are mainly composed of methane are called dry mixtures, whereas those mainly containing hydrocarbons such as propane, and butane are called wet mixtures.

Before being distributed for use, natural gas is treated to eliminate carbon dioxide and nitrogen, which make it less flammable, and hydrogen sulphide, a corrosive and toxic gas. The result is mainly methane. Methane is the simplest gaseous hydrocarbon and is characterised by the smallest molecule, including one carbon atom and four hydrogen atoms (CH4). It is lighter than the air (at a 15°C temperature and 1013.25 millibar pressure its specific weight is 0.678 kg/m³), it is colourless and odourless and not toxic.

It was very common in the primordial atmosphere of the Earth and probably contributed to the synthesis of the first amino acids and the creation of life on our planet. Mixed with the air, methane becomes flammable only if its concentration ranges between 5 and 15%. Below 5% the quantity of natural gas is insufficient to start the combustion, whereas above 15% the oxygen is insufficient. At temperature of 15°C and atmospheric pressure 1 cubic metre of methane produces over 8 thousand calories. In those conditions one cubic metre of methane has an energy content equivalent to 1.2 kg of coal and 0.83 kg of oil.

Methane becomes liquid at a critical temperature of −83°C and a pressure of 45 bars. The transformation into the liquid state can take place by decreasing temperature or increasing pressure. For example, at −161°C methane becomes liquid at room pressure.

The critical temperature of wet natural gases such as propane and butane, including 3 and 4 carbon atoms respectively, is higher than room temperature, therefore they become liquid simply by increasing pressure.

The origins of natural gas

On our planet hydrocarbons, including methane, are mainly located on rock pores that constitute the higher part of the Earth’s crust and result from chemical and physical processes that have taken place during the history of the Earth.

The action of atmospheric agents provokes the erosion of mountains whose debris, transported by water courses arrive at the sea, where sand and clay layers deposit. As well as the debris, sea-origin materials deposit on the seabed: salts that precipitate due to evaporation, and above all animals and materials that live in the sea. With time passing, due to crystallization of salts, sediments transform into compact rocks that still have some tiny holes occupied by water and organic substances. Subject to the micro-organisms disintegrating action, these organic substances convert into hydrocarbons like methane and oil. This process is called mineralization: plants and animals become gas, oil and coal, and these fuels are called “fossil” because they originated from the fossilization of plants and animals.

Where it is

The geographic location of gas reserves obviously mirrors that of oil: Russia, Iran and Qatar approximately have 53.4% of the total. Just like oil, the exploitation of gas fields takes place in a non-uniform way. For example, the Middle East countries extract little gas as compared to the reserves available. They have 40% of the world reserves and only produce 16.3% of the natural gas consumed in a year world-wide, whereas the U.S. and Western Europe show high levels of extraction (as compared to the available reserves). In fact, he U.S., despite possessing only 4.9% of the world’s proven reserves of natural gas, produce more than 20.7% of the gas produced in the world.

This means that, if the current production level remains unchanged and if no other fields are discovered, those countries (14 years for North America and approximately 19 for Europe) will deplete their reserves in a few years and will need to...
resort to imported gas only.
(Source: eni, World Oil and Gas Review 2015)

The reserves
World natural gas reserves total 201,771 billion cubic metres approximately (data refer to 31st December 2014). Such reserves include the currently known fields that can be exploited through the technology available to obtain an economic profit. They are not the actual total underground resources still unknown to mankind or the extraction of which would be too expensive. Nevertheless, they can be a good indication of the rate at which resources are being exploited (and depleted). If the currently known reserves are divided by the yearly world consumption of natural gas (in 2014, amounted to 3,444 billion cubic meters), at the current exploitation rate reserves will be depleted in approximately 58 years. There are certainly still unknown field which may extend the use of this fossil fuel, however the obvious conclusion is that natural gas, just like oil, is a resource bound to be depleted.
(Source: eni, World Oil and Gas Review 2015)

A bit of history
In a manuscript by the Chinese historian Chang Qu dated 347 B.C. a strange gas is described that can be used for illumination purposes. Approximately 200 years ago, Alessandro Volta “re-discovered” the energy potential of natural gas noticing small gas bubbles which formed when the muddy bottom of the Maggiore lake was stirred. If a lit match was approached, the gas contained in the bubble produced a bluish flame. Between 1840 and 1850 gas lights became common in many American and European cities and changed the lifestyle of citizens: well illuminated streets at night were an obstacle for thieves, ballrooms and clubs flourished even for less well-off people (since gas lights were cheaper than candles). Thos advantages were limited to where the natural gas came to the surface spontaneously, since no adequate technology was available to search for, extract and convey natural gas. For a long time the methane coming out of oil wells was burnt by means of a torch when it reached the surface. Several billion cubic metres of natural gas were burnt in the process: the biggest waste of resources in the history of mankind. Italy is one of the few countries where methane has been enhanced as an energy resource since the very discovery of fields in the Po valley and in the Adriatic sea. Natural gas, as a national energy source, remarkably contributed to the industrial development of Italy in the 1950s and 1960s. The exploitation of natural gas is a recent achievement: in Europe it started a little more than 50 years ago thanks to the development of technology which made its extraction economically viable and a pipeline network (i.e. the pipes to convey natural gas from the place of extraction to the place of consumption) to achieve a more efficient distribution. Pipelines currently run across the whole of Europe and make up the ideal transportation system because they have a low environmental impact: they do not increase surface traffic and are invisible, thanks to the restoration of the surrounding area after the digging to lay pipelines.