



Philosophy of Science: Matter and Matter as an Ontology of Chemistry

Bayu Saputra^{1*}, Suyitno Muslim²

¹Mahasiswa Program Doktor Teknologi Pendidikan, Universitas Negeri Jakarta

²Program Doktor Teknologi Pendidikan, Universitas Negeri Jakarta

Jl. R.Mangun Muka Raya No.11, Rawamangun, Kota Jakarta Timur, Indonesia

*Corresponding e-mail: bayudesmonn@gmail.com

muslimsuyitno27@gmail.com

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Abstract: Philosophy of Science: Matter and Matter as an Ontology of Chemistry.

Philosophy and science can be used by humans as an effort to understand the concepts and methods of a scientific discipline. Substantially and historically, philosophy and science have an important role in giving great influence to human life. One of the sciences, namely chemistry, is no exception, which has a major influence on human life. Ontology in chemistry can be understood as a science that discusses what we want to know and a study of chemical theory. A more in-depth ontology of chemistry is a discussion in order to find or get the essence of something related to chemistry. Chemistry is defined as the study of matter, its properties, structure, and changes in matter and the energy that accompanies these changes. This article aims to explain the ontology of chemistry, namely substances and matter according to experts and their development. This article uses qualitative research methods which include literature studies, where a review of books and journals is carried out to enrich and the results of empirical research are used as secondary data to strengthen arguments which are then synthesized into a single unit to provide meaningful information. The results showed that there are two ontological aspects of chemistry, namely the concept of chemistry which means the composition, nature, structure, change and energy that accompanies the change of a material and the object of chemistry, namely substance or matter.

Keywords: Substance and Matter, Chemical Ontology

Abstrak: Filsafat Ilmu: Materi dan Materi sebagai Ontologi Kimia. Filsafat dan ilmu dapat digunakan oleh manusia sebagai upaya memahami konsep dan metode suatu disiplin ilmu. Secara substansial dan historis, filsafat dan ilmu pengetahuan memiliki peran penting dalam memberikan pengaruh yang besar bagi kehidupan manusia. Tidak terkecuali salah satu ilmu pengetahuan yaitu ilmu kimia yang mempunyai pengaruh besar bagi kehidupan manusia. Ontologi dalam kimia dapat dipahami sebagai ilmu yang membahas tentang apa yang ingin kita ketahui dan kajian tentang teori kimia. Ontologi kimia yang lebih mendalam adalah pembahasan dalam rangka menemukan atau mendapatkan intisari dari sesuatu yang berhubungan dengan kimia. Kimia didefinisikan sebagai studi tentang materi, sifat-sifatnya, struktur, dan perubahan materi dan energi yang menyertai perubahan ini. Artikel ini bertujuan untuk menjelaskan tentang ontologi kimia yaitu zat dan materi menurut para ahli dan perkembangannya. Artikel ini menggunakan metode penelitian kualitatif yang meliputi studi kepustakaan, dimana dilakukan telaah buku dan jurnal untuk memperkaya dan hasil penelitian empiris dijadikan sebagai data sekunder untuk memperkuat argumentasi yang kemudian disintesis menjadi satu kesatuan untuk memberikan informasi yang bermakna. Hasil penelitian menunjukkan bahwa ada dua aspek

ontologi kimia, yaitu konsep kimia yang berarti komposisi, sifat, struktur, perubahan dan energi yang menyertai perubahan suatu materi dan objek kimia, yaitu zat atau materi.

Kata kunci: *Zat dan Materi, Ontologi Kimia*

• INTRODUCTION

Philosophy can be viewed as a human endeavor to deal responsibly with fundamental questions regarding various problems faced by humans (Suseno, 1993). Philosophy is also the basis of human thinking as reasoning reason in seeking and exploring a science. Philosophy and science can be used by humans as an effort to understand a concept and method of a scientific discipline (Fadli, 2021). Substantially and historically, philosophy and science have an important role in providing a major influence on human life (Bakhtiar, 2012). Science for Western philosophers is enough to be obtained only by using reason or reason, without the influence of religion. Meanwhile, philosophy in the Islamic world resulted in a renewal of the main principles of religious teachings and knowledge itself (Soelaiman, 2019). One of the philosophers of the Islamic world, Al-Ghazali defines science as the result of knowing activity, namely the discovery of a reality into the soul so that there is no doubt about it and belief is an absolute requirement for the soul to be able to know (Al-Ghazali, 1995). Al-Ghazali classifies science into *fardu ain* and *fadu kifayah* (Al-Ghazali, 1995). One of the sciences of *fardu kifayah* is chemistry.

Chemistry comes from the Arabic language, namely *al-kimiya* which means change of matter, by the Arab scientist Jabir Bin Hayyan. In more detail, chemistry is defined as the study of matter, its properties, structure, and changes in matter and the energy that accompanies these changes (Chang, 2005). There are at least four fundamental concepts in chemistry which also became the beginning of the history of the development of chemistry. The discussion and study of the thought and history of chemistry cannot be separated from the four fundamental concepts, namely pure substance, elements and compounds (element and compound), molecules, atoms, and atomic particles (molecule, atom, and subatomic particle), and energy (energy) (Caldin, 2002).

From the time of classical Greek philosophy and alchemy to the development of modern chemistry in the 19th century, the idea of matter, elements, compounds, and their transformations has become a central issue and this issue has become the basis for philosophical systems as well as the target of critical reflection (Borchert, 2006). This means that there are two ontological aspects of chemistry, namely the concept of chemistry which means the composition, nature, structure, change and energy that accompanies the change of a material and the object of chemistry is substance or matter. So this article aims to describe the object of chemistry (ontological chemistry), namely substances and materials according to experts.

• METHOD

Literature study was used in writing this article. The study of books and journals is carried out for the study of chemistry, namely about substances and developmental materials and the science of their development according to experts. In addition, the

results of empirical research are used as secondary data to strengthen arguments which are then synthesized into a single unit to provide meaningful information.

• DISCUSSION

The foundation of science is directed at the components that become the pillars for the existence of science, namely ontology, epistemology, and axiology. The study of ontology refers to the nature under study. Epistemology is related to the process which includes its sources, characteristics, nature, and truth. While axiology is related to the use value (Jujun, 2006). This philosophical perspective can enrich the view of science (Halik, 2020).

In more detail, ontology was first introduced by Rudolf Goclenius to name the theory of metaphysical nature which is often also called proto-philosophy or the first philosophy (Susanto, 2011). The issue of ontology becomes the main discussion in the field of philosophy, which discusses reality. Reality is a reality that then leads to something truth. The reality in this ontology raises the questions: what is the real nature of this existing reality?, is this apparent reality just a material reality?, does this reality consist of one element, two elements, or pluralism? (Suminar, 2019).

Ontology in chemistry can be understood as a science that discusses what we want to know and a study of chemical theory. A more in-depth ontology of chemistry is a discussion in order to find or get the essence of something related to chemistry. Chemistry itself can be understood as the science of the characteristics of matter, the form of matter (phase), the substances contained, and the interaction of matter with other materials (in the form of synthesis, chemical transformation, and methods of separation) (Brakel, 2014). Three categories of ontology of chemistry are needed to bring order and diversity of matter, namely the notion of matter, the notion of chemical substances, and the notion of closely related chemical species (Brakel, 2014).

Not much different, one of the pioneers of modern chemistry in the Islamic world is Jabir Bin Hayyan who, although influenced by mysticism, Jabir always uses empirical principles and scientific methods based on experiments and contrary to developments that tend to be rational speculative only, argues that important concepts in chemistry starting with pure matter and matter (Chandra, 2012). This means that ontology in chemistry concerns matter and pure substances. Jabir Bin Hayyan also expressed the importance of understanding the relationship between philosophy and chemistry (Jabir, 1935). Philosophy is used as the initial basis for understanding chemical phenomena. The initial foundation of this philosophy will be found what phenomena are questions of reality regarding chemistry, how to find out about these phenomena and how these phenomena are developed based on experiments and then based on theories, and what values are related to morals towards utility. these phenomena (Chandra, 2012).

Matter is defined as anything that has mass and occupies space (Chang, 2005). Living and non-living things consist of matter, be it humans, plants, animals, water, stones, wood, salt, and other objects (Jabir, 1935). Matter is solid, liquid, and gas (Chang, 2005). Matter is divided into two parts, namely simple substances and complex substances (Jabir, 1935).

According to other modern chemists, a single substance (a simple substance) is matter in which all its parts have the same properties and composition. Every pure substance has special properties that distinguish it from other pure substances. So that a pure substance can be known based on its form, smell, taste, color, and various other properties. For example copper, iron, oxygen, and others. Some pure substances can be

formed from several other substances but the properties of the constituent substances are not visible, such as pure water formed from hydrogen and oxygen but the explosive nature of hydrogen gas is not visible in pure water (Jabir, 1935).

In the view of modern chemistry, there is confusion over the meaning of pure substances according to Jabir Bin Hayyan, namely when complex substances are defined as compounds. In the modern chemical sense, a compound is part of a single substance. Pure substances are divided into elements and compounds. An element is a single substance that cannot be separated into simpler substances by chemical means. Currently, 113 elements have been identified, 83 of which occur naturally on earth and the rest have been created by scientists. While compounds are part of a single substance in addition to elements (Chang, 2005). Compounds are defined as substances resulting from the combination of two or more elements, which can still be further broken down into their constituent elements through chemical reactions (Knight, 2002). For example, water is composed of hydrogen and oxygen, table salt is composed of sodium and chlorine, baking soda is composed of sodium, carbon, hydrogen, and oxygen (Jabir, 1935). Furthermore, it is explained that compounds and matter consist of the elements fire, air, earth, and water. Each of these elements has 4 kinds of properties, namely hot, dry, cold, moist which includes three types of objects, namely plants, animals, and stones (Jabir, 1953). Described as follows:

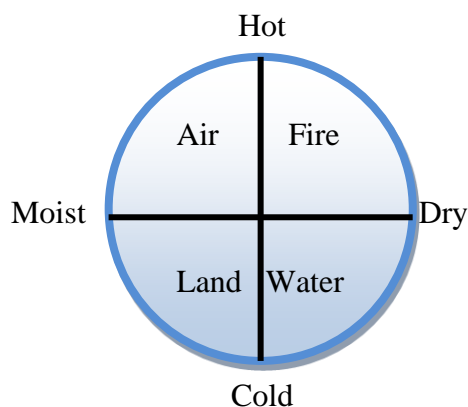


Fig. 4 kinds of properties, namely hot, dry, cold, moist which includes three types of objects, namely plants, animals, and stones (Jabir, 1953).

This view is actually not new because it has been put forward by Greek philosophers. Greek philosophers recognized that matter in everyday life has varied properties such as wood, textiles, food, living things, even water and air. Similar to the pure materials known in ancient times, even metals such as silver and gold varied in properties according to the impurities they contained. In Aristotle's theory there may be an infinite variety of properties, depending on the balance of the four roots or elements namely fire, air, earth and water. Experience has finally shown, however, that from everyday matter it is possible to extract what chemists call pure substances, which are homogeneous, and possess reproducible properties.

These ideas were fundamental to the scientific development of chemistry and it can be seen that they gave rise to empirical laws of an important kind. This became clear in the mid-eighteenth century, and its application became more widespread with the

development of quantitative analysis. More can be established or obtained for many substances by the analysis of Proust (1769 to 1808), made in response to Berthollet's opinion that chemical composition is composed of four variables. This was taken for granted before the development of new theories, by Lavoisier, for example, and was a presupposition of his work on the difference between elements and compounds (Caldin, 2002).

• CONCLUSION

The views of Islamic chemists and modern scientists agree on the basis of the development of chemistry seen from its ontology covering matter and matter. At first the experts found the idea of matter and matter containing four elements, namely fire, air, earth, and water. Furthermore, it is explained empirically through the search of the scientific method that matter is defined as anything that has mass and occupies space, while a single substance is matter whose all parts have the same properties and composition.

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