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STOICHIOMETRY IN CHEMISTRY AS A REFLECTION OF THE VALUES OF THE QUR'AN

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ABSTRACT

Penelitian ini mengeksplorasi integrasi nilai-nilai Islam dalam pendidikan kimia, khususnya berfokus pada stoikiometri. Stoikiometri, sebuah konsep kunci dalam kimia yang menekankan keseimbangan dan proporsionalitas, selaras dengan prinsip-prinsip keadilan dan keseimbangan sebagaimana disoroti dalam Al-Qur'an. Penelitian ini bertujuan untuk menganalisis bagaimana prinsip-prinsip ilmiah ini mencerminkan nilai-nilai Al-Qur'an dan bagaimana prinsip-prinsip tersebut dapat diterapkan dalam lingkungan pendidikan. Metode kualitatif deskriptif digunakan, dengan memanfaatkan penelitian kepustakaan untuk mengumpulkan data dari literatur kimia dan tafsir Al-Qur'an. Penelitian ini menemukan kesamaan yang signifikan antara hukum-hukum stoikiometri dan ajaran Al-Qur'an tentang keseimbangan, ketepatan, dan keteraturan dalam penciptaan. Ayat-ayat seperti Surat Ar-Rahman (55:7-9) menekankan untuk menjaga keseimbangan, yang mencerminkan pentingnya keseimbangan dalam reaksi kimia. Studi ini menyimpulkan bahwa mengintegrasikan nilai-nilai ini ke dalam pendidikan kimia dapat memberikan pemahaman holistik tentang sains, memperkuat perspektif agama dan ilmiah

This research explores the integration of Islamic values in chemistry education, particularly focusing on stoichiometry. Stoichiometry, a key concept in chemistry that emphasizes balance and proportionality, is aligned with the principles of justice and balance as highlighted in the Qur'an. The study aims to analyze how these scientific principles reflect Qur'anic values and how they can be applied in educational settings. A descriptive qualitative method was employed, utilizing library research to gather data from chemical literature and Qur'anic commentaries. The research found significant parallels between the laws of stoichiometry and the Qur'anic teachings on balance, precision, and order in creation. Verses such as Surah Ar-Rahman (55:7-9) emphasize maintaining balance, which mirrors the necessity of balance in chemical reactions. The study concludes that integrating these values into chemistry education can provide a

holistic understanding of science, reinforcing both religious and scientific perspectives

INTRODUCTION

Recent research has explored the integration of Islamic perspectives into chemistry education, particularly in topics such as atomic structure and stoichiometry. Studies have shown that the Qur'an contains concepts that align with modern chemical understanding of atoms and molecules.[1] This integration aims to demonstrate the relevance of the Qur'an to natural sciences and provide guidance for humanity. In teaching stoichiometry, the Four-Step Material Development Method (4-STMD) has been used to incorporate Islamic values, resulting in materials that are highly understandable and suitable for chemistry education.[2] Additionally, the development of discovery-based learning modules for basic chemistry, especially stoichiometry, has shown positive effects on students' learning outcomes. These modules have proven to be valid, practical, and effective in the learning process, significantly impacting students' basic chemistry knowledge.[3]

Chemistry, developed and inherited by Muslim scholars during the Islamic Golden Age, continues to make significant contributions to modern civilization. The concepts and chemical industries from that era remain relevant today, and European scholars and contemporary scientists acknowledge that the foundations of modern chemistry were laid by Muslim chemists. Jabir ibn Hayyan is recognized as the father of modern chemistry due to his groundbreaking discoveries. Will Durant, in his book, refers to Muslim scholars as the founders of chemistry because they introduced detailed controlled methods of observation and experimentation, laying the foundations for modern chemistry and making it a valuable science for industry.[4]

The integration of Islam and science involves merging the fields of scientific knowledge and Islamic teachings into a unified whole,[5] with the Qur'an and Sunnah serving as foundational

[1] Sabarni Sabarni, "Atom dan Molekul Berdasarkan Ilmu Kimia dan Perspektif Al-Qur'an," *Lantanida Journal* 7, no. 1 (July 9, 2019): 87, https://doi.org/10.22373/lj.v7i1.4647.

[2] Siti Suryaningsih, Buchori Muslim, and Nurul Anjar Wati, "Islamic Values in the Use of Four Steps Teaching Material Development (4-STMD) Method in Teaching Stoichimetry Material," *TARBIYA: Journal of Education in Muslim Society* 7, no. 1 (September 23, 2020): 78–87, https://doi.org/10.15408/tjems.v7i1.14066.

[3] Anita Debora Br Simangunsong and Eva Pratiwi Pane, "Pengembangan Modul Kimia Dasar Berbasis Discovery Learning Pada Materi Stoikiometri," *EDUKATIF : Jurnal Ilmu Pendidikan* 3, no. 6 (September 29, 2021): 4415–25, https://doi.org/10.31004/edukatif.v3i6.1472.

[4] Is Fatimah et al., "Refleksi Nilai-Nilai Keislaman Pada Perkembangan Dan Aplikasi Ilmu Kimia" (Universitas Islam Indonesia, 2017), https://dspace.uii.ac.id/handle/123456789/11284.

[5] Fauzan Fauzan, "Integrasi Islam Adan Sains Dalam Kurikulum Program Studi Pendidikan Guru MI Berbasis KKNI," *JMIE (Journal of Madrasah Ibtidaiyah Education)* 1, no. 1 (2017), https://e-journal.adpgmiindonesia.com/index.php/jmie/article/view/21.

theories.[6] From an Islamic viewpoint, justice and balance are core values highlighted in the Qur'an. For example, *Surah Ar-Rahman (55:7)* states that Allah created everything with precise measure and balance, instructing Muslims to uphold fairness and equilibrium in all aspects of life. This principle parallels the concept of balance in stoichiometry.

Islam encourages the pursuit of scientific knowledge and technological advancement as a means to understand Allah's creation and benefit humanity.[7] The Islamic worldview provides a comprehensive framework for scientific endeavors, promoting exploration of nature and offering guidance for applied technology development,[8] like Kuntowijoyo advocate for the integration of Islamic principles with scientific knowledge, proposing concepts such as the "Islamization of knowledge" to bridge the perceived gap between religion and science.[9] Islam views scientific knowledge as essential for human welfare and a means to better understand Allah, considering it part of humanity's obligation as rational beings created by Allah.[10] Throughout history, Muslim scientists have made significant contributions to various fields of natural sciences, highlighting Islam's emphasis on knowledge acquisition and scientific progress.[11]

This research aims to explore in greater depth how stoichiometric principles in chemistry can be understood and integrated with the values of justice and balance found in the Qur'an. By understanding this connection, it is hoped that a more holistic understanding of how scientific and religious principles interrelate can be achieved, leading to a broader perspective on justice and balance in human life.

RESEARCH METHOD

The research method used in this research is descriptive qualitative research with a library research approach, as explained by George, that library research involves systematic exploration of existing literature, documents, and information sources to gather insights, facts, and data

[6] Muhammad Munadi, "Integration of Islam and Science: Study of Two Science Pesantrens (Trensain) in Jombang and Sragen," *Jurnal Pendidikan Islam* 5, no. 2 (2016): 287–303.

[7] Muhammad Nahadi, Farida Sarimaya, and Sri R. Rosdianti, "Hubungan Islam Dengan Ilmu Pengetahuan Alam Dalam Perspektif Sejarah," *Atikan* 1, no. 1 (2011), https://www.journals.mindamas.com/index.php/atikan/article/view/104; Rasyiani Putri, Adelio Ramadhan, and Muhammad Afif, "Perspektif Islam Terhadap Integrasi Perkembangan Ilmu Teknologi," *ADI Bisnis Digital Interdisiplin Jurnal* 2, no. 1 Juni (2021): 48–54.

[8] Putri, Ramadhan, and Afif, "Perspektif Islam Terhadap Integrasi Perkembangan Ilmu Teknologi."

[9] Nur Azizah, "Hubungan Ilmu Dan Agama Dalam Prespektif Islam Telaah Pemikiran Kuntowijoyo," *Prosiding Konferensi Integrasi Interkoneksi Islam Dan Sains* 1 (2018): 151–56.

[10] Eman Supriatna, "Islam Dan Ilmu Pengetahuan," *Jurnal Soshum Insentif*, 2019, 128–35.

[11] Nahadi, Sarimaya, and Rosdianti, "Hubungan Islam Dengan Ilmu Pengetahuan Alam Dalam Perspektif Sejarah."

related to a topic.[12] This study aims to explore and describe the relationship between the principles of stoichiometry in chemistry and the values contained in the Qur'an.

The research focuses on two main aspects: first, an in-depth study of the fundamentals of stoichiometry, including its laws and applications in modern chemistry, and second, an examination of the moral and scientific values in the Qur'ān related to these scientific principles. The main data sources for this study consist of chemical literature, such as textbooks, scientific articles, and journals that elaborate on the concept of stoichiometry, as well as Qur'anic commentaries and academic writings that discuss the teachings of the Qur'an in depth.

Data were collected through literature studies by reviewing various relevant documents to find the relationship between the concept of stoichiometry and the values contained in the Qur'an. The data analysis technique used is thematic and qualitative analysis, which aims to identify the main themes and describe how scientific principles in stoichiometry can relate to religious teachings in the Qur'an.

RESULT AND DISCUSSION

The word *"stoichiometry"* in chemistry comes from the Greek, namely *"stoikheion"* which means *"element"* or *"basic element"* and "metron" which means *"measure"*.[13] The term was introduced by Jeremias Benjamin Richter, a German chemist in the late 18th century, who noticed that in chemical reactions, there is a fixed quantitative relationship between the reactants and the products produced. Stoichiometry, thus, refers to the measurement and calculation of the amount of substances in a chemical reaction, both in terms of mass and moles.[14]

Interestingly, there are some etymological and conceptual links with stoichiometry in Arabic. The Arabic word for element is "عنصر" (ʿunsur), which means element or basic component, similar to the meaning of "stoikheion" in Greek. In addition, the word for "measure" or "balance" in Arabic is "ميزان" (mīzān), which literally means a weighing device, but also refers to a balance, similar to the concept of "metron" which means measurement in stoichiometry.
Furthermore, the Qur'an in some verses, such as in Surah Al-Hadid (57:25) and Surah Al-Mulk (67:3).

[12] Mary W. George, "The Elements of Library Research: What Every Student Needs to Know," 2008, https://www.torrossa.com/gs/resourceProxy?an=5579538&publisher=FZO137.

[13] Ernst von Meyer, "A History of Chemistry from Earliest Times to the Present Day (3rd English Edition, Translated by G. McGowan)" (Macmillan & Co., London, 1906).

[14] Kira Padilla and Andoni Garritz, "The Pedagogical Content Knowledge of University Chemistry Professors Teaching Stoichiometry," in *Proceedings of the NARST 2011 Conference*, 2011, https://andoni.garritz.com/documentos/2013/21_Padilla-Garritz_NARST_2011.pdf.

لَقَدْ أَرْسَلْنَا رُسُلَنَا بِالْبَيِّنَاتِ وَأَنزَلْنَا مَعَهُمُ الْكِتَابَ وَالْمِيزَانَ لِيَقُومَ النَّاسُ بِالْقِسْطِ ۖ وَأَنزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ وَمَنَافِعُ لِلنَّاسِ وَلِيَعْلَمَ اللَّهُ مَنْ يَنصُرُهُ وَرُسُلَهُ بِالْغَيْبِ ۚ إِنَّ اللَّهَ قَوِيٌّ عَزِيزٌ

"We verily sent Our messengers with clear proofs, and revealed with them the Scripture and the Balance, that mankind may observe right measure; and He revealed iron, wherein is mighty power and (many) uses for mankind, and that Allah may know him who helpeth Him and His messengers, though unseen. Lo! Allah is Strong, Almighty"

"ٱلَّذِى خَلَقَ سَبْعَ سَمَٰوَٰتٍ طِبَاقًا ۖ مَّا تَرَىٰ فِى خَلْقِ ٱلرَّحْمَٰنِ مِن تَفَٰوُتٍ ۖ فَٱرْجِعِ ٱلْبَصَرَ هَلْ تَرَىٰ مِن فُطُورٍ"

"Who hath created seven heavens in harmony. Thou (Muhammad) canst see no fault in the Beneficent One's creation; then look again: Canst thou see any rifts?"

The verses of Surah Al-Hadid (57:25) and Surah Al-Mulk (67:3) emphasize the importance of balance and order in creation, which resonates with the principles of stoichiometry in chemistry. Al-Hadid (57:25) speaks of the "balance" or equilibrium that Allah revealed to establish justice, which is similar to the concept of stoichiometry that ensures the balance between reactants and products in chemical reactions, in accordance with the law of conservation of mass. Al-Mulk (67:3) emphasizes that the universe was created flawlessly and with precise measurements, reflecting how stoichiometry also regulates the correct dosage of each element in chemical reactions to make them work perfectly, reflecting the harmony of nature.

In the Qur'an and hadith, although not discussed directly about the basic laws of chemistry or stoichiometry, scientific principles such as balance, size, and order are implied in messages about the creation and order of the universe. Several verses in the Qur'an as well as the views of scholars in Islamic history have links to the basic concepts of science, including chemistry. The principles of stoichiometry, which include mole calculations, equating reaction equations, limiting reagents, and the basic laws of chemistry, can be explained in the context of Islamic values that emphasize balance and accuracy in every creation.

The Concept of Mole and Surah Al-Qamar (54:49)

إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ

"Verily, all things have We created in proportion and measure."

The concept of a mole is one of the basic principles in stoichiometry used to calculate the amount of a substance.[15] A mole is defined as the number of particles (atoms, molecules, or ions) in a substance equal to Avogadro's number, which is about 6.022 x 10^{23} particles.[16] Moles are used in chemistry to facilitate calculations related to chemical reactions, especially in equating reaction equations and calculating the mass of substances required or produced in the reaction.[17]

According to Tafsir Ibn Kathir, verse 49 of Surah Al-Qamar explains that Allah SWT has determined the size for each of His creatures and provides guidance to all of them. The relevance of this verse to the concept of the mole is that it shows that the mole provides a precise and measurable way to calculate the number of particles in a substance, just as Allah created nature with a definite size. In chemical processes, whether in the laboratory or in natural phenomena, the amounts of reactants and products must be measured precisely to ensure the appropriate reaction outcome. This shows the harmony between Allah's provision in creation and chemistry's precision in counting particles.

Law of conservation of mass surah Al Asr (103:1-2) and surah al Qamar (54:49)

وَالْعَصْرِ *إِنَّ الْإِنسَانَ لَفِي خُسْرٍ

"*By (the Token of) Time (through the ages)" * "Verily Man is in loss"*

This verse emphasizes the importance of time and how every second of it keeps going, without being stopped or reversed. This concept is similar to the law of eternity which states that time continues and cannot be destroyed or eliminated.

إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ

" Verily, all things have We created in proportion and measure."

[15] P. A. Huddle and A. E. Pillay, "An In-Depth Study of Misconceptions in Stoichiometry and Chemical Equilibrium at a South African University," *Journal of Research in Science Teaching* 33, no. 1 (January 1996): 65–77, https://doi.org/10.1002/(sici)1098-2736(199601)33:1<65::aid-tea4>3.0.co;2-n.

[16] Carmen J. Giunta, "The Mole and Amount of Substance in Chemistry and Education: Beyond Official Definitions," *Journal of Chemical Education* 92, no. 10 (October 13, 2015): 1593–97, https://doi.org/10.1021/ed5007376.

[17] Carlos Furio, Rafael Azcona, and Jenaro Guisasola, "The Learning and Teaching of the Concepts 'Amount of Substance'and 'Mole': A Review of the Literature," *Chemistry Education Research and Practice* 3, no. 3 (2002): 277–92.

In the beginning, Chemistry was only the knowledge of mixing and separating substances in a certain ratio. However, Antoine Laurent Lavoisier (1743-1794) changed this approach by insisting that chemistry should be presented quantitatively. Through his meticulous experiments, Lavoisier measured precise amounts of substances and formulated the Law of Conservation of Mass in 1789.[18] This law, also known as the Lomonosov-Lavoisier Law, states that the mass of a closed system will be constant despite the various processes taking place within it. In other words, mass is neither created nor destroyed in a chemical reaction, so the total mass of the substance before and after the reaction remains the same.[19] This principle is one of the fundamental bases in chemistry. It means that, although chemical changes occur in a reaction, the total mass of the reactants and products does not change. For example, in the reaction of burning glucose, the total mass of glucose and oxygen reacted will be equal to the total mass of carbon dioxide and water produced. In the reaction as follows.

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$$

This principle is very important in stoichiometry, as it allows scientists to calculate the masses of reactants and products with precision, which is essential for accurately understanding and designing chemical reactions.[20]

The verse in Surah Al-Qamar (54:49) which states that “everything is created according to measure” reflects the order and precision also found in chemistry, especially in the law of conservation of mass. Every chemical reaction is subject to this law, so the mass of the substance is always in balance. This shows that order in natural laws, including in chemical reactions, is a manifestation of the decrees that Allah has created.

Equalization of Chemical Reaction Equations and Surah Ar-Rahman (55:7-9)

وَالسَّمَاءَ رَفَعَهَا وَوَضَعَ الْمِيزَانَ *أَلَّا تَطْغَوْا فِي الْمِيزَانِ *وَأَقِيمُوا الْوَزْنَ بِالْقِسْطِ وَلَا تُخْسِرُوا الْمِيزَانَ

*" And the Firmament has He raised high, and He has set up the Balance (of Justice)” * “In order that ye may not transgress (due) balance” * “So establish weight with justice and fall not short in the balance”*

[18] Raymond Chang, “Kimia Dasar: Konsep-Konsep Inti Edisi Ketiga Jilid 2,” 2005.

[19] Zul Alfian, *Kimia Dasar* (USUpress, 2009), https://books.google.com/books?hl=id&lr=&id=ikCyoR6aaWAC&oi=fnd&pg=PR3&dq=hukum+kekekalan+massa+kimia&ots=owEuTCuILV&sig=SpTcKZ6YsmBVEvLwHXbMQ8UA26Q.

[20] Nurfa’izin Safa’ah et al., “KIMIA DASAR,” *Kimia Dasar*, 2024.

One of the main principles in stoichiometry is the equalization of chemical reaction equations. In every chemical reaction, the number of atoms in the reactants must be equal to the number of atoms in the products, in accordance with the law of conservation of mass proposed by Lavoisier. This means, in a chemical reaction, no atoms are lost or created, but only rearranged.[21] For example, in the methane combustion reaction:

$$CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$$

The number of carbon, oxygen, and hydrogen atoms on both sides of the equation must be equal.[22] This equalization process reflects the principle of balance that Allah created in the universe, as mentioned in Surah Ar-Rahman. In chemistry, an imbalance in equalizing the reaction equation will lead to incorrect results, such as the mass of the product that does not match the prediction. The principle of "do not break the balance" in this verse can be analogized to the importance of maintaining balance in chemical reactions so that nothing is wrong or missed.

Substance Transformation Process (Combustion Reaction) and Surah Yasin (36:79-80)

قُلْ يُحْيِيهَا الَّذِي أَنْشَأَهَا أَوَّلَ مَرَّةٍ وَهُوَ بِكُلِّ خَلْقٍ عَلِيمٌ *الَّذِي جَعَلَ لَكُمْ مِنَ الشَّجَرِ الْأَخْضَرِ نَارًا فَإِذَا أَنْتُمْ مِنْهُ تُوقِدُونَ

*" Say, "He will give them life Who created them for the first time! for He is Well-versed in every kind of creation!"" * ""The same Who produces for you fire out of the green tree, when behold! ye kindle therewith (your own fires)!"*

The verse from Surah Yasin (36:79-80) contains metaphors about the transformation of substances that are closely related to chemical processes, particularly combustion reactions. For example, the burning of wood or trees that produces fire is an example of a chemical reaction in which the fuel (wood) reacts rapidly with oxygen. In this process, the molecular bonds of the reactants are broken and the atoms and electrons are rearranged into new products. The elements in the combustible fuel undergo rapid oxidation, producing energy in the form of heat and light.[23] This reaction shows how organic substances such as wood change form through combustion.

[21] Estiningsih Tri Handayani, *Kimia Dasar* (Pascal Books, 2022), https://books.google.com/books?hl=id&lr=&id=B3ljEAAAQBAJ&oi=fnd&pg=PA2&dq=penyetaraan+reaksi+kimia&ots=S2jXNVSrF4&sig=cpqfi7BgeJSKG4eTyDjbvmRywhc.

[22] Chang, "Kimia Dasar."

[23] Werlin S. Nainggolan, "Thermodinamika," *Bandung, CV Armico*, 1987.

According to Ismail bin Umar Al-Quraisyi bin Katsir in the book Tafsir Ibn Katsir, this verse explains the power of Allah who creates trees from water so that they become green and fresh, then Allah makes them dry wood that can be used as fuel. This process illustrates natural transformation, where substances change from one state to another according to His will. This interpretation relates how Allah, who is able to create fire from green wood, is also able to revive dead creatures. In stoichiometry, the process of burning the wood reflects the balance between reactants and products, where the total mass of the burnt substance remains equal to the mass of the products of combustion. This is in line with the principle of stoichiometry which ensures that no mass is lost in a chemical reaction, but only undergoes transformation according to the law of conservation of mass.

In chemistry, this reaction can be described by the following equation:

$$C_xH_y + O_2 \rightarrow CO_2 + H_2O$$

It describes the transformation of substances from solid form (wood or hydrocarbons) to gases such as carbon dioxide and water. As in the verse, Allah created a natural process where a substance is transformed into useful energy. In stoichiometry, combustion reactions are calculated using the number of moles of reactants and products, ensuring that all atoms are accounted for in these changes.[24]

Limiting Reagents and Surah Al-Hijr (15:19)

وَالْأَرْضَ مَدَدْنَاهَا وَأَلْقَيْنَا فِيهَا رَوَاسِيَ وَأَنْبَتْنَا فِيهَا مِنْ كُلِّ شَيْءٍ مَوْزُونٍ

" And the earth We have spread out (like a carpet); set thereon mountains firm and immovable; and produced therein all kinds of things in due balance."

Limiting reagent is a concept in stoichiometry that states that the outcome of a chemical reaction is determined by a limited number of available reagents. If a reagent runs out, then the

[24] Wahyono Suprapto, *Baja Dan Aplikasinya* (Universitas Brawijaya Press, 2023), https://books.google.com/books?hl=id&lr=&id=njPuEAAAQBAJ&oi=fnd&pg=PR4&dq=,+reaksi+pembakaran+dihitung+dengan+menggunakan+jumlah+mol+reaktan+dan+produk,+memastikan+bahwa+semua+atom+terhitung+dalam+perubahan+ini.&ots=xm0vHTfIFV&sig=A6lLqVja4fCvHjJK9btwqQr-QhQ.

reaction cannot continue, even if other reagents still remain.[25] This is an important principle in determining the efficiency and maximum yield of a chemical reaction.

For example, in the following reaction:

$$2H_2 + O_2 \rightarrow 2H_2O$$

If there is only 1 mole of oxygen and 4 moles of hydrogen, oxygen becomes the limiting reagent, and only 2 moles of water can be produced, even though there is still hydrogen left. This shows that nature works with definite limits and measures, as explained in Surah Al-Hijr. Everything, including chemical results, is determined by exact measurements.

The Regularity of Chemical Reactions and Natural Cycles in Surah Al-Anbiya (21:33)

وَهُوَ الَّذِي خَلَقَ اللَّيْلَ وَالنَّهَارَ وَالشَّمْسَ وَالْقَمَرَ كُلٌّ فِي فَلَكٍ يَسْبَحُونَ

" It is He Who created the Night and the Day, and the sun and the moon: all (the celestial bodies) swim along, each in its rounded course."

The verse in Surah Al-Anbiya (21:33) describes the orderliness of the universe, where day and night, the sun and the moon, all run in a regular trajectory.[26] This principle of regularity can be analogized to the concept of stoichiometry in chemistry, particularly in chemical reaction cycles. In chemistry, many natural processes such as the carbon cycle or nitrogen cycle follow a regular repeating pattern, where the products of one reaction become the reactants for the next reaction.[27] These regularities and cycles reflect the harmony created by God in the universe.

The order described in this verse is in line with how chemical reactions require balance and order to proceed efficiently. Just as the universe runs according to set laws, chemical reactions also follow certain laws, such as the law of conservation of mass and the principle of stoichiometry, to maintain a balance between reactants and products. This shows that chemistry and the order of nature both reflect the harmony created by God.

Stoichiometry involves not only the law of conservation of mass, but also the principle of balance and proper proportion in any chemical reaction. Each atom and molecule on the reactant

[25] Unggul Sudarmo, "Kimia Untuk SMA/MA Kelas XI Jilid 2" (Bandung. PHIβ ETA, 2006).
[26] M. Quraish Shihab, "Tafsir Al-Misbah," *Jakarta: Lentera Hati* 2 (2002): 52–54.
[27] Mochamad Ramdhan Firdaus and Lady Ayu Sri Wijayanti, "Fitoplankton Dan Siklus Karbon Global," *Oseana* 44, no. 2 (2019): 35–48.

side must be equivalent to its amount on the product side, ensuring no atoms are lost or created. This principle is very similar to the concept of balance described in the Qur'an, particularly in Surah Ar-Rahman (55:7-9), which emphasizes the importance of maintaining balance in His creation. Balance in chemical reactions reflects the harmony of nature, where each element has its role in achieving equilibrium.

Jabir ibn Hayyan, a prominent Muslim scientist, developed the modern concept of stoichiometry that allows quantitative calculation of the relationship between reactants and products in chemical reactions. He introduced a method that accurately calculates the proportions of elements, in harmony with the principle of balance that underlies all of creation. This concept is not only important in chemistry, but also in life, where balance and justice are the foundation of order.[28]

The interpretation of Ibn Jarir al- Thabari in his tafsir Jami' al-Bayan fi Ta'wil al-Quran supports this. In verse 7, Allah created the heavens with balance, and in verse 8, there is a call to humans to maintain justice, especially in weights and measures, as warned by Ibn 'Abbas that negligence to maintain balance in this matter destroyed the previous nations.[29] In the context of stoichiometry, this principle of balance is reflected in the precision of chemical reactions, where each element must be calculated correctly to achieve the desired result, similar to the importance of maintaining justice in social life.

Precision and balance in stoichiometry are very important in various chemical applications, both on a laboratory and industrial scale. The use of the concept of proportion in chemical calculations ensures that chemical reactions take place efficiently and produce the desired product without any waste of reactants. This is in line with the Qur'anic injunction to maintain balance and harmony in life, as affirmed in Surah Ar-Rahman. Imbalances in chemical reaction calculations can lead to inappropriate results, similar to imbalances in nature that can destroy the harmony of the universe.

Although the Qur'an and hadith do not directly discuss chemistry, the basic principles taught in the Qur'an such as balance, order, and precision are very relevant to the concepts in stoichiometry. Chemistry, which emphasizes precision and accuracy in the calculation of mass, moles, and volume of substances, reflects values that emphasize the importance of balance and harmony in God's creation. The contributions of Muslim scientists such as Jabir ibn Hayyan, who provided an important basis for the development of stoichiometry, confirm that Islamic teachings

[28] Anne Rooney, *The Story of Chemistry* (Arcturus Publishing, 2017), https://books.google.com/books?hl=id&lr=&id=pu1ADwAAQBAJ&oi=fnd&pg=PT9&dq=J%C3%A2bir+ibn+Hayy%C3%A2n+quantitative+calculation+methods+in+chemistry&ots=FpYMRk9EFS&sig=OXZgaSNQ9_s9EyDDY76C0tpNCZI.

[29] Muhammad Ibn Jarir, "Tafsir Al-Tabari-Jami 'al-Bayan Fi Ta'Wil al-Quran.'" (Abdullah bin 'Abd Al-Muhsin Al-Turkiyy (Ed.). Jld, 2001).

have a significant role in the development of science and technology, which ultimately reflects the harmony between the teachings of the Qur'an and the laws of nature.

CONCLUSION

The principles of stoichiometry in chemistry, such as mass balance, moles, and reaction equalization, are closely related to the values of balance, order, and precision taught in the Qur'an. Verses such as Surah Al-Hadid (57:25) and Surah Ar-Rahman (55:7-9) emphasize the importance of maintaining balance in creation, which is in line with the concept of stoichiometry in ensuring balance between reactants and products in chemical reactions. The law of conservation of mass in stoichiometry also reflects the Qur'anic teachings on size and precision in creation, as affirmed in Surah Al-Qamar (54:49). In addition, the contribution of Muslim scientists such as Jabir ibn Hayyan in developing the basics of stoichiometry shows that Islamic values of justice and balance play an important role in the advancement of chemistry. Thus, stoichiometry is not only essential in science, but also reflects harmony with the Qur'anic teachings on the orderliness of the universe that was created with the right measurements

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