Asian Journal of Chemical Sciences

12(2): 31-38, 2022; Article no.AJOCS.89847
ISSN: 2456-7795

What Principle Governs the Chemical Dynamic/Kinetic Process (2)?

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/AJOCS/2022/v12i219144

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/89847

Original Research Article

Received 21 May 2022
Accepted 28 July 2022
Published 01 August 2022

ABSTRACT

In this work we explored the detail relation between the positive and reverse chemical reaction rates. It is found that the differential relation between the positive and reverse chemical reaction rates is not simple counter relation. Furthermore, it is revealed that the dynamic/kinetic process automatically broke the symmetry of the nature and during the differential process, the positive and reverse chemical reactions allow duplication. The detail odd-even principle has been elucidated in this work.

Keywords: Dynamic/kinetic process; "Yin and Yang" philosophy; chemical reaction; differential process; mirror symmetry broken; duplication; galaxy.

1. INTRODUCTION

The chemical reaction is one of the major forces to promote the evolution in the nature. At the beginning, the pioneer scientists tried their best to elucidate the mechanism of chemical reaction. After long time continuous effort, a lot of famous scientists made their contributions to the foundation of the modern theory about the mechanism of the chemical reaction. Here we would like mentioning the Arrhenius [1] and Boltzmann [2], both of them paid much attention to the chemical dynamic/kinetic process and made their distinguishing contributions to the modern theory of the chemical dynamic/kinetic process. Due to the continuous effort in scientific world [3,4,5], now the modern theory about the chemical dynamic/kinetic process has been setup. Most of the mechanism of the chemical reaction can be elucidated quite well, therefore,

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nobody doubt that the understanding the chemical reaction and revealing the mechanism of the chemical reaction are even if not finished but at least nearly finished.

As we mentioned in our previous work [6], even for the chemical dynamic/kinetic process, if we consider in different philosophic view [7], we may find some new characters which we ignored before. Here we would like following the same clue proposed in our previous work [6], to explore the basic principle of the dynamic/kinetic process, which is unknown to us.

2. THEORY AND DISCUSSION

In order to simplify our discussion, we start with the first order chemical reaction here [8].

$$\frac{d(C_0-C)}{dt} = kC \quad (1)$$

Where C_0, C, t and k are the starting concentration of reactant, the concentration of the reactant at time t, the reaction time and the rate constant, respectively.

$$\frac{-dC}{dt} = kC \quad (2)$$

$$\frac{-dC}{C} = kdt \quad (3)$$

$$\int_{C_0}^{C} \frac{dC}{C} = -\int_0^t kdt \quad (4)$$

$$ln\frac{C}{C_0} = -kt \quad (5)$$

$$C = C_0 e^{-kt} \quad (6)$$

Based on the mathematical principle (see appendix a), the eq. (6) can be rewritten as

$$C = C_0\left(1 - x + \frac{x^2}{2!} - \frac{x^3}{3!} + \cdots\right) \quad (7)$$

Where x=kt.

For the terms in bracket in eq. (7), the negative terms make the reactant concentration decrease, whereas the positive terms make the reactant concentration increase. Therefore, we can define from A to B as positive reaction, from B to A as reverse reaction and A, B are the reactant and product, respectively. This case exactly matches the “Yin and Yang” philosophy which is developed in ancient China (see appendix b) [9].

From these discussions, we get,

$$r_+ = -x - \frac{x^3}{3!} - \frac{x^5}{5!} \ldots \quad (8)$$

$$r_- = \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} \ldots \quad (9)$$

Then the eq. (7) can be rewritten as

$$C = C_0(1 + r_+ + r_-) \quad (10)$$

Based on the mathematical principle (see appendix a), we can get

$$r_+ + r_- + 1 = e^{-x} \quad (11)$$

$$r_- - r_+ + 1 = e^{x} \quad (12)$$

$$r_+ = \frac{e^{-x} - e^{x}}{2} \quad (13)$$

$$r_- = \frac{e^{-x} + e^{x}}{2} - 1 \quad (14)$$

These formulas above are the result obtained in our previous work [6]. Following we would like exploring the differential relation between the positive and reverse reaction rates in detail.

1. The differential relation between the positive and reverse reaction rates

$$\frac{dr_-}{dx} = -r_+ \quad (15)$$

$$\frac{d^2r_-}{dx^2} = r_- + 1 \quad (16)$$

$$\frac{d^3r_-}{dx^3} = -r_+ \quad (17)$$

$$\frac{d^nr_-}{dx^n} = -r_+ \quad \text{(n=odd integer)} \quad (18)$$

$$\frac{d^nr_-}{dx^n} = r_- + 1 \quad \text{(n=even integer)} \quad (19)$$

Whereas for $\frac{dr_+}{dx}$, we have

$$\frac{dr_+}{dx} = -r_- - 1 \quad (20)$$

$$\frac{d^2r_+}{dx^2} = r_+ \quad (21)$$

$$\frac{d^3r_+}{dx^3} = -r_- - 1 \quad (22)$$

$$\frac{d^nr_+}{dx^n} = -r_- - 1 \quad \text{(n=odd integer)} \quad (23)$$

$$\frac{d^nr_+}{dx^n} = r_+ \quad \text{(n=even integer)} \quad (24)$$

From the eq. (15) to (24), we find the relation between the differential positive reaction rate and the reverse reaction rate is not a simple counter relation. When the differential order (n) is odd, the differential positive reaction rate equals to $-r_- - 1$, not just r_-, but have to add 1 and the negative sign. Based on "Yin and Yang" philosophy [9] the nature is controlled by "Yin and Yang" philosophy, and the evolution or change in the nature is promoted by the "Yin and Yang" characters but this doesn't mean the evolution or change in the nature is simply recycled. Corresponding each "cycle", the nature is evolved forward, not just come back to the starting point. That is the meanings of the constant 1 and negative sign attached to these changes.

Second point it should be stressed is "Yin and Yang" philosophy also allows to self copy or duplicate, which is verified in the expression $\frac{d^n r_+}{dx^n} = r_+$ (n=even integer). But this self copy or duplication is not equally allowed between r_+ and r_-. For r_-, $\frac{d^n r_-}{dx^n} = -r_+$ (n=odd integer) only allowed to copy its counter part, r_+ , in negative way (see the negative sign "-" in front of r_+ in eq.(18)). This means in the nature, the evolution or change broke the symmetry of nature automatically. This kind of symmetry broken in the nature due to the dynamic/kinetic process may be the reason why the human body is only composed of the left chiral materials.

The third point we should stress here is the odd-even integer description. For example, for $\frac{d^n r_+}{dx^n}$, when n is odd integer, the evolution or differential process is related to $-r_- - 1$, but if n is even integer, this evolution or differential process is duplicated, and this odd-even integer description is different from $\frac{d^n r_+}{dx^n}$ to $\frac{d^n r_-}{dx^n}$ (see from eq.(15) to eq.(19)).

The asymmetry differential evolution description means that the nature doesn't allow simply to be repeated. And the whole dynamic/kinetic process in the nature can't keep the perfect symmetry, which is the basic motivation for the evolution in the nature.

From the discussion above, we noticed that the "Yin and Yang" characters are not exactly mirrored each other, and the relation between the "Yin and Yang" is the symmetry broken. That's why our nature continuously evolves forward but never simply repeats.

2. How to express the dynamic/kinetic process graphically?

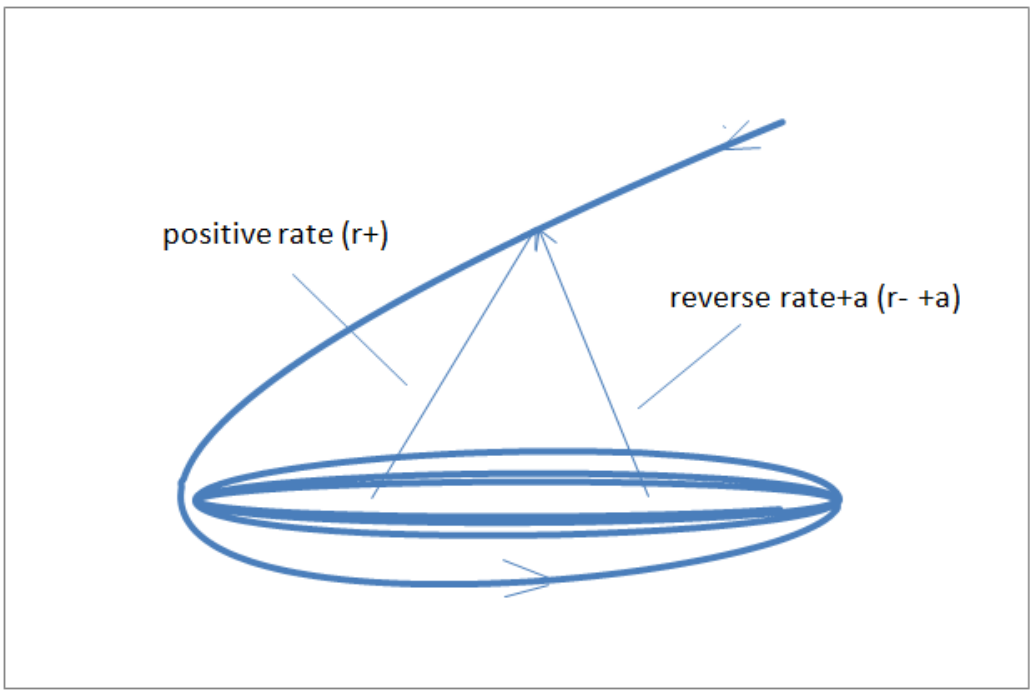

Fig. 1. The dynamic/kinetic process for the first order chemical reaction

Fig. 1 clearly shows that the dynamic/kinetic process in system is not simply repeated but a little changed for each period in cycle. Conventionally, the dynamic/kinetic process can be expressed by drawing the rate ~ t (that is, $\frac{dC}{dt} \sim t, the\ following\ is\ the\ same$) [6]. The traditional way to express the dynamic/kinetic process by drawing the rate ~ t is simple, clear and easier to understand, especially for the beginner. The shortcomings is in that the traditional method by drawing the rate ~ t is difficult to reveal the whole dynamic/kinetic process. Here we would like offering a new way to graphically reveal the whole dynamic/kinetic process in one figure.

From the eq.(13) and (14), we found if rearranging a little, we can show the whole dynamic/kinetic process in elliptic coordinate.

Taking μ= e^{-x} , v= e^{x}, R=1, we get,

$$r_+ = \frac{e^{-x}-e^{x}}{2} = \frac{R(\mu-\nu)}{2} \quad (25)$$

$$r_- + a = \frac{e^{-x}+e^{x}}{2} = \frac{R(\mu+\nu)}{2} \quad (26)$$

Where a is constant (for the first order chemical reaction, a=1 and R=1).

If we take r_+ and $r_- + a$ as the rate vectors, we can express these vectors in elliptic (see Fig. 1).

Fig.1 tells us that the dynamic/kinetic process in system behaves like elliptic. Following this elliptic path, we can determine the reverse reaction rate from the positive rate or vice versa.

From Fig. 1, we can clearly see how the dynamic/kinetic process in system develops with the time, energy barrier and temperature. And for these variables, we only need one graph and know how to exchange the unit among the different variables.

As we pointed out above, the positive sign (see eq. (24)) and negative sign (see eq. (18)) tell us that the evolutions of the positive rate and reverse rate are not kept symmetry in the process. Furthermore, the eq. (18) also reveals that for the reverse rate, it doesn't allow to duplicate like the positive rate (see eq. (24)) but only can copy to the positive rate in negative way (see the negative sign in eq. (18)). For the reverse rate only can be duplicated but with deficit (see eq. (19), for which the self copy process needs a constant compensation, for the first order chemical reaction, the compensation constant is 1). This situation happened for positive rate also (see eq. (23)).

3. Is the principle of the dynamic/kinetic process discovered here generally valid?

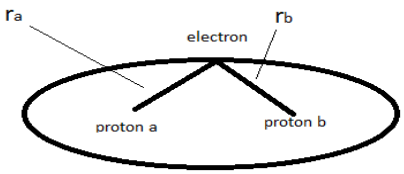

Fig. 2a. The hydrogen molecular ion

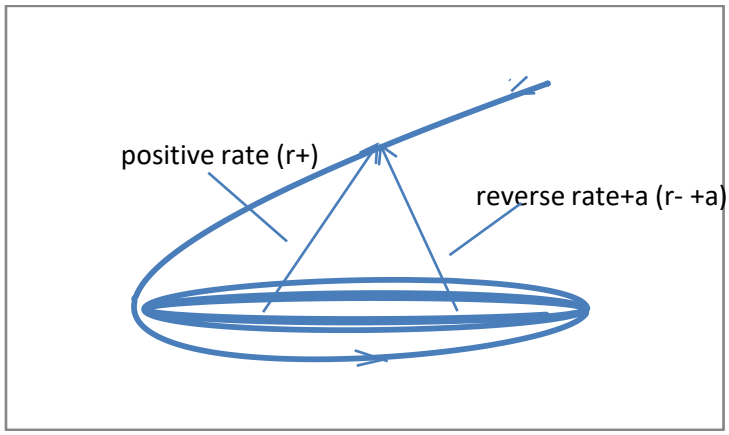

Fig. 2b. The dynamic/kinetic process for the first order chemical reaction

Fig. 2c. The galaxy system

Fig. 2. The dynamic/kinetic processes for three typical systems

In the equation derivation from eq.(1) to eq.(26), we didn't introduce any assumption or condition, that means the principle about the dynamics/kinetics discovered here is generally valid. This conclusion includes the dynamic/kinetic process from the microworld (such as the atom/molecule system) to the macro world and cosmic system (such as chemical reaction and Galaxy system). If the system is stable, the compensation constant should be zero (see the constant a in eq.(26)), then the system will keep perfect elliptic path, such as the hydrogen molecular ion system (Fig. 2a) [10]. If the compensation constant (a) is not zero, the system is unstable and will continuously evolve with the variables, such as time, energy barrier and temperature. The typical examples are the chemical reaction (Fig. 2b) and the Galaxy system (Fig. 2c) [11]. To my knowledge, in order to explain the behaviors of the Galaxy, some researchers proposed the "dark energy" and "dark matter" concepts [12,13]. However, based on our result here, we don't need inventing these "dark energy" and "dark matter" concepts to explain the behaviors of the Galaxy. All the behaviors of the Galaxy system are controlled by the same principle of the dynamic/kinetic system revealed in our work here.

From Fig. 1, we noticed that even though for each period, the path is changed gradually, but the foci for the positive and reverse rates are kept relatively stable, that means the foci are not changed for each period, just the elliptic path for each period are changed. This means that the centers of the positive rate and reverse rate are relatively stable and connected together, not independent each other. This kind of relation between the positive rate and reverse rate obey the "Yin and Yang" philosophy, that is, the positive rate and reverse rate are the two faces for one dynamic/kinetic system. Both of them cooperatively promote the evolution of the dynamic/kinetic process in the Nature.

At the present, the physical meaning for the property of foci for the dynamic/kinetic system is still unclear. Based on our result here, even for the Galaxy system, there should exist the foci also. All the evolution in the Galaxy system is going on around the foci. We will continue working on these aspects and the result will be presented later.

3. CONCLUSION

In this work, we discussed the detail about the relation between the positive and reverse chemical reaction rates. It is found that the relation between the positive and reverse chemical reaction rates is not simple opposing relation. It is revealed that the symmetry in the nature is automatically broken during the dynamic/kinetic process. Furthermore, during the differential process, the positive and reverse chemical reaction rates allow duplicating, and this duplicating process obeys the odd-even rule.

Conflicts of Interest: The author declares no conflicts of interest regarding the publication of this paper.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Arrhenius SA. A Dynamic Theory of the Electromagnetic Field. Philosophical Transactions of Royal Society of London. 1889;155:459-512.
2. Partington JR. An Advanced Treatise on Physical Chemistry, Fundamental Principles, the Properties of Gases; London: Longmans Green and Co. 1949; 1:300.
3. Alkharashi SA, Sirwah M. Dynamical Responses of Inclined Heated Channel of MHD Dusty Fluids Through Porous Media; J. Eng. Math. 2021;130:5.
   Available:https://doi.org/10.1007/s10665-021-10160-0
4. Alkharashi SA, Al-Hamad Khaled, Alrashidi Azizah. An Approach Based on the Porous Media for Multilayered Flow in the Presence of Interfacial Surfactants, Pramana-, J. Phys. 2022;96:140.
   Available:https://doi.org/10.1007/s12043-022-02385-0
5. Macklem PT. Emergent Phenomena and the Secrets of Life. J. Applied Physiology. 2008;104(6):1844-1846.
   DOI: 10.1152/japplphysiol.00942.2007
   Available:https://doi.org/10.1152%2Fjapplphysiol.00942.2007
   PMID: 18202170
   (https://pubmed.ncbi.nlm.nih.gov/18202170).
6. Wei-Xing Xu. What Principle Governs the Chemical Dynamic/kinetic Process?; Asian Journal of Chemical Sciences. 2020;8(4): 95-102.
   DOI: 10.9734/ajocs/2020/v8i419059
7. De Koninck, Charles. The philosophy of Sir Arthur eddington and the problem of indeterminism. The Writings of Charles de Koninck. Notre Dame, Ind.: University of Notre Dame Press; 2008.
   ISBN 978-0-268-02595-3. OCLC 615199716.
   Available:https://www.worldcat.org/oclc/615199716
8. IUPC, Compendium of Chemical Terminology 2^{nd} Edition, Blackwell Scientific, Oxford; 1997.
9. Yin and Yang. Philosophy;
   Available:https://en.wikipedia.org/wiki/yin and yang
10. Wei-Xing Xu. Revisit the Hydrogen Molecular Ion; Current Journal of Applied Science and Technology. 2022;41(9):35-41.
    DOI: 10.9734/cjast/2022/v41i931689
11. Available:en.wikipedia.org/wiki/Galaxy
12. Zwicky F. On the Masses of Nebulae and of Clusters of Nebulae. The astrophysical Journal, An International Review of Spectroscopy and Astronomical Physics. 1937;86(3):217-246.
13. Mira-Cristiana Anisiu. Vera Rubin and the hypothesis of Dark matter existence; Didactica Mathematica. 2028;36:13-23.

APPEDIX A

From the literature, we know that,

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots \quad \text{(a1)}$$

$$e^{-x} = 1 - x + \frac{x^2}{2!} - \frac{x^3}{3!} + \cdots \quad \text{(a2)}$$

Here we can define two series, that is,

$$S_1(x) = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} \ldots \quad \text{(a3)}$$

$$S_2(x) = -x - \frac{x^3}{3!} - \frac{x^5}{5!} - \cdots \quad \text{(a4)}$$

Then,

$$S_1(x) - S_2(x) = e^x \quad \text{(a5)}$$

$$S_1(x) - S_2(x) = e^{-x} \quad \text{(a6)}$$

From equation (a5) and equation (a6), we can get,

$$S_1(x) = \frac{e^x + e^{-x}}{2} \quad \text{(a7)}$$

$$S_2(x) = \frac{e^{-x} - e^x}{2} \quad \text{(a8)}$$

The function $S_1(x)$ and $S_2(x)$ have following properties,

$$S_1^2(x) + S_2^2(x) = \frac{\left(e^{2x} + e^{-2x}\right)}{2} \quad \text{(a9)}$$

$$S_1^2(x) - S_2^2(x) = 1 \quad \text{(a10)}$$

$$S_1(x) \times S_2(x) = \frac{\left(e^{-2x} - e^{2x}\right)}{4} \quad \text{(a11)}$$

$$S_1^{'}(x) = -S_2(x) \quad \text{(a12)}$$

$$S_2^{'}(x) = -S_1(x) \quad \text{(a13)}$$

$$S_1^{''}(x) = S_1(x) \quad \text{(a14)}$$

$$S_2^{''}(x) = S_2(x) \quad \text{(a15)}$$

APPENDIX B

"Yin and Yang" can be thought of as complementary (rather than opposing) forces that interact to form a dynamic system in which the whole is greater than the assembled parts. According to this philosophy, everything has both "Yin and Yang" aspects which push the system constantly evolving. Therefore, the ancient Chinese thinker believed that "Yin and Yang" principle is generally valid in our universe.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/89847