International Journal of Current Research in Science and Technology
Volume 4, Issue 3 (2018), 17–21.
ISSN: 2394-5745
Available Online: http://ijcrst.in/

International Journal of Current Research in Science and Technology

# Hyper-Revan Indices and their Polynomials of Silicate Networks

**V. R. Kulli[1,*]**

1 Department of Mathematics, Gulbarga University, Gulbarga, India.

**Abstract:** We propose the first and second hyper-Revan indices of a molecular graph. Considering these hyper-Revan indices, we define the first and second hyper-Revan polynomials of a graph. In this paper, we compute the first and second hyper-Revan indices and their polynomials of certain family of networks such as silicate networks.

**MSC:** 05C05, 05C07, 05C35.

**Keywords:** Hyper-Revan indices, silicate network.



## 1. Introduction

A molecular graph is a graph whose vertices correspond to the atoms and the edges to the bonds, Chemical graph theory has an important effect on the development of Chemical Sciences, see [1]. Let $G$ be a finite, simple, connected graph with vertex set *V(G)* and edge set *E(G)*. The degree $d_G(v)$ of a vertex $v$ is the number of vertices adjacent to $v$. Let $\Delta(G)(\delta(G))$ denote the maximum (minimum) degree among the vertices of $G$. The revan vertex degree of a vertex $v$ in $G$ is defined as $r_G(v) = \Delta(G) + \delta(G) - d_G(v)$. The revan edge connecting the revan vertices $u$ and $v$ will be denoted by $uv$. We refer [2], for other undefined notations and terminologies. The first and second Revan indices of a graph $G$ are defined as

$$R_1(G) = \sum_{uv \in E(G)} [r_G(u) + r_G(v)], \quad R_2(G) = \sum_{uv \in E(G)} r_G(u) r_G(v).$$

The Revan indices were introduced by Kulli in [3] and were studied, for example, in [4, 5]. Considering the Revan indices, the first and second Ravan polynomials [6] of a graph were defined as follows:
The first and second Revan polynomials of a graph $G$ are defined as

$$R_1(G,x) = \sum_{uv \in E(G)} x^{r_G(u)+r_G(v)}, \quad R_2(G,x) = \sum_{uv \in E(G)} x^{r_G(u) r_G(v)}.$$

We introduce the first and second hyper-Revan indices as

$$HR_1(G) = \sum_{uv \in E(G)} [r_G(u) + r_G(v)]^2, \quad HR_2(G) = \sum_{uv \in E(G)} [r_G(u) r_G(v)]^2.$$

* *E-mail: vrkulli@gmail.com*

Considering hyper-Revan indices, we propose the first and second hyper-Revan polynomials of a graph $G$ as

$$HR_1(G,x) = \sum_{uv\in E(G)} x^{[r_G(u)+r_G(v)]^2}, \quad HR_2(G,x) = \sum_{uv\in E(G)} x^{[r_G(u)r_G(v)]^2}.$$

The third Revan index [3] of a graph $G$ is defined as

$$R_3(G) = \sum_{uv\in E(G)} |r_G(u) - r_G(v)|.$$

Considering the third Revan index, Kulli defined the third Revan polynomial [5] as

$$R_3(G,x) = \sum_{uv\in E(G)} x^{|r_G(u)-r_G(v)|}.$$

Recently, several topological indices were studied, for example, in [7–17]. In this paper, the first and second hyper-Revan indices and their polynomials of silicate networks are determined. For silicate networks see [5].

## 2. Results

A silicate network is symbolized by $SL_n$ where n is the number of hexagons between the center and boundary of $SL_n$. These networks are obtained by fusing metal oxides or metal carbonates with sand. A silicate network of dimension 2 is depicted in Figure 1.

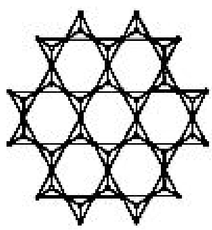

Figure 1: A 2-dimensional silicate network

Let $G$ be the graph of silicate network $SL_n$. By calculation, $G$ has $15n^2 + 3n$ vertices and $36n^2$ edges. From Figure 1, it is easy to see that the vertices of $SL_n$ are either of degree 3 or 6. Thus $\Delta(G) = 6$, $\delta(G) = 3$ and therefore $r_G(u) = 9 - d_G(u)$. In $SL_n$, by algebraic method, there are three types of edges based on the degree of the vertices of each edge as follows:

$$E_{33} = \{uv \in E(G) | d_G(u) = d_G(v) = 3\}, \quad |E_{33}| = 6n.$$

$$E_{36} = \{uv \in E(G) | d_G(u) = 3, d_G(v) = 6\}, \quad |E_{36}| = 18n^2 + 6n.$$

$$E_{66} = \{uv \in E(G) | d_G(u) = d_G(v) = 6\}, \quad |E_{66}| = 18n^2 - 12n.$$

Thus there are three types of Revan edges based on the degree of end Revan vertices of each Revan edge as given in Table 1.

| $r_G(u), r_G(v)$ / $uv \in E(G)$ | (6,6) | (6, 3) | (3,3) |
|---|---|---|---|
| Number of edges | 6n | $18n^2$+ 6n | $18n^2 - 12n$ |

Table 1: Revan edge partition of $G$

In the following theorem, we compute the value of $R_1(SL_n, x)$, $R_2(SL_n, x)$ for silicate networks.

**Theorem 2.1.** *The first and second Revan polynomials of a silicate network are given by*

*(1).* $R_1(SL_n, x) = 6nx^{12} + (18n^2 + 6n)x^9 + (18n^2 - 12n)x^6$.

*(2).* $R_2(SL_n, x) = 6nx^{36} + (18n^2 + 6n)x^{18} + (18n^2 - 12n)x^9$.

*Proof.* Let $G$ be the graph of silicate network $SL_n$.

(1). By using the partition given in Table 1, we can apply the formula of the first Ravan Polynomial of silicate network $SL_n$. Since $R_1(G, x) = \sum_{uv \in E(G)} x^{r_G(u)+r_G(v)}$, this implies that

$$R_1(SL_n, x) = 6nx^{6+6} + (18n^2 + 6n)x^{6+3} + (18n^2 - 12n)x^{3+3}.$$
$$= 6nx^{12} + (18n^2 + 6n)x^9 + (18n^2 - 12n)x^6.$$

(2). By using the partition given Table 1, we can apply the formula of the second Revan Polynomial of silicate network $SL_n$. Since $R_2(G, x) = \sum_{uv \in E(G)} x^{r_G(u)r_G(v)}$, this implies that

$$R_1(SL_n, x) = 6nx^{6\times 6} + (18n^2 + 6n)x^{6\times 3} + (18n^2 - 12n)x^{3\times 3}.$$
$$= 6nx^{36} + (18n^2 + 6n)x^{18} + (18n^2 - 12n)x^9.$$

□

In the following theorem, we compute the third Revan index and its polynomial of silicate networks.

**Theorem 2.2.** *The third Revan index and its polynomial of a silicate network are given by*

*(1).* $R_3(SL_n) = 54n^2 + 18n$.

*(2).* $R_3(SL_n, x) = (18n^2 + 6n)x^3 + (18n^2 - 6n)$.

*Proof.* Let $G$ be the graph of silicate network $SL_n$.

(1). By using the partition given in Table 1, we can apply the formula of the third Revan index of silicate network $SL_n$. Since $R_3(G) = \sum_{uv \in E(G)} |r_G(u) - r_G(v)|$, this implies that

$$R_3(SL_n) = 6n \times 0 + \left(18n^2 + 6n\right)3 + \left(18n^2 - 12n\right) \times 0.$$
$$= 54n^2 + 18n.$$

(2). By using the partition given in Table 1, we can apply the formula of the third Revan Polynomial of silicate network $SL_n$. Since $R_3(G, x) = \sum_{uv \in E(G)} x^{|r_G(u)-r_G(v)|}$, this implies that

$$R_3(SL_n, x) = 6nx^0 + \left(18n^2 + 6n\right)x^3 + \left(18n^2 - 12n\right)x^0.$$
$$= \left(18n^2 + 6n\right)x^3 + \left(18n^2 - 6n\right).$$

□

In the following theorem, we compute the value of $HR_1(SL_n)$ and $HR_2(SL_n)$ for silicate networks.

**Theorem 2.3.** *The first and second hyper-Revan indices of a silicate network are given by*

*(1).* $HR_1(SL_n) = 2106n^2 + 918n$.

*(2).* $HR_2(SL_n) = 7290n^2 + 8748n$.

*Proof.* Let $G$ be the graph of silicate network $SL_n$.

(1). By using the partition given in Table 1, we can apply the formula of the first hyper-Revan index of $G$. Since $HR_1(G) = \sum\limits_{uv \in E(G)} [r_G(u) + r_G(v)]^2$, this implies that

$$\begin{aligned} HR_1(SL_n) &= 6n\,(6+6)^2 + \left(18n^2 + 6n\right)(6+3)^2 + \left(18n^2 - 12n\right)(3+3)^2 . \\ &= 2106n^2 + 918n. \end{aligned}$$

(2). By using the partition given in Table 1, we can apply the formula of the second hyper-Revan index of $G$. Since $HR_2(G) = \sum\limits_{uv \in E(G)} [r_G(u)\, r_G(v)]^2$, this implies that

$$\begin{aligned} HR_2(SL_n) &= 6n\,(6 \times 6)^2 + \left(18n^2 + 6n\right)(6 \times 3)^2 + \left(18n^2 - 12n\right)(3 \times 3)^2 . \\ &= 7290n^2 + 8748n. \end{aligned}$$

□

In the following theorem, we compute the first and second hyper-Revan polynomials of silicate networks.

**Theorem 2.4.** *The first and second hyper-Revan Polynomials of a silicate network are given by*

*(1).* $HR_1(SL_n, x) = 6nx^{144} + (18n^2 + 6n)x^{81} + (18n^2 - 12n)x^{36}$.

*(2).* $HR_2(SL_n, x) = 6nx^{1296} + (18n^2 + 6n)x^{328} + (18n^2 - 12n)x^{81}$.

*Proof.* Let $G$ be the graph of silicate network $SL_n$.

(1). By using the partition given Table 1, we can apply the formula of the first hyper-Revan polynomial of a silicate network $SL_n$. Since $HR_1(G, x) = \sum\limits_{uv \in E(G)} x^{[r_G(u) + r_G(v)]^2}$, this implies that

$$\begin{aligned} HR_1(SL_n, x) &= 6nx^{(6+6)^2} + \left(18n^2 + 6n\right)x^{(6+3)^2} + \left(18n^2 - 12n\right)x^{(3+3)^2}. \\ &= 6nx^{144} + (18n^2 + 6n)x^{81} + (18n^2 - 12n)x^{36}. \end{aligned}$$

(2). By using the partition given in Table 1, we can apply the formula of the second hyper-Revan polynomial of a silicate network $SL_n$. Since $HR_2(G, x) = \sum\limits_{uv \in E(G)} x^{[r_G(u) r_G(v)]^2}$, this implies that

$$\begin{aligned} HR_2(SL_n, x) &= 6nx^{(6\times 6)^2} + \left(18n^2 + 6n\right)x^{(6\times 3)^2} + \left(18n^2 - 12n\right)x^{(3\times 3)^2}. \\ &= 6nx^{1296} + (18n^2 + 6n)x^{324} + (18n^2 - 12n)x^{81}. \end{aligned}$$

□

## References


[1] I.Gutman and O.E.Polansky, *Mathematical Concepts in Organic Chemistry*, Springer, Berlin, (1986).

[2] V.R.Kulli, *College Graph Theory*, Vishwa International Publications, Gulbarga, India (2012).

[3] V.R.Kulli, *Revan indices of oxide and honeycomb networks*, International Journal of Mathematics and its Applications, 5(4-E)(2017), 663-667.

[4] V.R.Kulli, *On the product connectivity Revan index of certain nanotubes*, Journal of Computer and Mathematical Sciences, 8(10)(2017), 562-567.

[5] V.R.Kulli, *The sum connectivity Revan index of silicate and hexagonal networks*, Annals of Pure and Applied Mathematics, 14(3)(2017), 401-406.

[6] V.R.Kulli, *Revan indices and their polynomials of certain rhombus networks*, submitted.

[7] V.R.Kulli, *On the product connectivity reverse index of silicate and hexagonal networks*, International Journal of Mathematics and its Applications, 5(4-B)(2017), 175-179.

[8] V.R.Kulli, *On the sum connectivity reverse index of oxide and honeycomb networks*, Journal of Computer and Mathematical Sciences, 8(9)(2017), 408-413.

[9] V.R.Kulli, *Geometric-arithmetic reverse and sum connectivity reverse indices of silicate and hexagonal networks*, International Journal of Current Research in Science and Technology, 3(10)(2017), 29-33.

[10] V.R.Kulli, *Reverse Zagreb and reverse hyper-Zagreb indices and their polynomials of rhombus silicate networks*, Annals of Pure and Applied Mathematics, 16(1)(2018), 47-51.

[11] V.R.Kulli, *General Zagreb polynomials and F-polynomial of certain nanostructures*, International Journal of Mathematical Archive, 8(10)(2017), 103-109.

[12] V.R.Kulli, *Certain topological indices and their polynomials of dendrimer nanostars*, Annals of Pure and Applied Mathematics, 14(2)(2017), 263-268.

[13] V.R.Kulli, *General fifth M-Zagreb indices and fifth M-Zagreb polynomials of PAMAM dendrimers*, International Journal of Fuzzy Mathematical Archive, 13(1)(2017), 99-103.

[14] V.R.Kulli, *On K-hyper-Banhatti indices and coindices of graphs*, International Research Journal of Pure Algebra, 6(5)(2016), 300-304.

[15] V.R.Kulli, *The Gourava indices and coindices of graphs*, Annals of Pure and Applied Mathematics, 14(1)(2017), 33-38.

[16] V.R.Kulli, *On the sum connectivity Gourava index*, International Journal of Mathematical Archive, 8(7)(2017), 211-217.

[17] V.R.Kulli, *New multiplicative arithmetic-geometric indices*, Journal of Ultra Scientist of Physical Sciences, A, 29(6)(2017), 205-211.