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ARTICLE

On ev and ve-Degree Based Topological Indices of Silicon Carbides

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ABSTRACT

In quantitative structure-property relationship (QSPR) and quantitative structure-activity relationship (QSAR) studies, computation of topological indices is a vital tool to predict biochemical and physio-chemical properties of chemical structures. Numerous topological indices have been inaugurated to describe different topological features. The ev and ve-degree are recently introduced novelties, having stronger prediction ability. In this article, we derive formulae of the ev-degree and ve-degree based topological indices for chemical structure of $Si_2C_3 - I[a,b]$.

KEYWORDS

Topological indices; silicon carbide; ev-degree; ve-degree

1 Introduction

Researchers have found applications of graph theory and topological models in various scientific research fields during last decades. Theoretical physics, toxicology, computer sciences, pharmacology, pharmaceutical chemistry, engineering and architecture are diverse areas utilizing graph theory and models to make numerous improvements in existing scientific literature [1–4]. Consequently, the collaboration of chemistry and graph theory leads towards foundation of extensive research work. Topological indices (TIs) are result of this alliance, which are numeric parameters used to describe characteristics of molecular graphs of chemical compounds and help in quantitative structure-property relationship (QSPR) and quantitative structure-activity relationship (QSAR), see [5–7].

TIs assist in the course of investigation and prediction of the physio-chemical and biochemical properties, i.e., dipole moment, charge density, stability, melting and boiling points, inter-molecular forces and bond lengths, without laboratory experiments, which reduces consumption of time and cost [1,8–12]. Randíc index, Zagreb index, atom-bond connectivity index, geometric index, harmonic index, etc. [13–19] are some well-known TIs. Recently, Chellali et al. [20] introduced two new degree novel approaches in graph theory, known as ev-degree and ve-degree. Mathematical concepts related to ve-degree and ev-degree are also discussed by Horoldagva et al. [21]. Randíc and Zagreb indices are calculated in [22–24] using ev-degree and ve-degree concepts and found that predicting power of ve-degree Zagreb index is stronger than that of classic Zagreb index.

Silicon, the second most abundant element on earth, has unique physical and chemical properties due to its semi-conductance and nontoxic nature. Silicon carbides has diverse industrial applications because of thermal and chemical stability, high erosion resistance, high melting point, non oxidizing behavior [25–27]. These characteristics and low cost production techniques give superiority to silicon carbides over other semi conductors. Different metal components used in digital gadgets are replaced by silicon carbides due to its power saving property [28,29]. These are widely used in wind turbines, electrical vehicles, solar cells along with different high radiation and temperature tolerant applications.

The main objective of the article is to derive formulae to calculate the ev-degree and ve-degree based TIs for $Si_2C_3 - I[a,b]$ and study the behavior of the obtained results through mathematical tools.

2 Preliminaries

Let $G(V,E)$ be a graph with V vertex set and E edge set. The degree of a vertex ν is the number of edges incident to ν. Two vertices in a graph are said to be adjacent if these are connected with each other by an edge. Open neighborhood of a vertex ν, denoted by $N(\nu)$ is the set of vertices adjacent to ν and if we include ν itself, then set is called closed neighborhood of ν, denoted by $N[\nu]$. The ev-degree of an edge $e = \nu\mu$ is the number of vertices in union of closed neighborhood sets of ν and μ, denoted by $d_{ev}(e)$ and number of edges incident to different vertices in closed neighborhood of ν is ve-degree of a vertex ν, denoted by $d_{ve}(\nu)$. Some recent results on the ev-degree and ve-degree based topological indices can be seen in [30]. The definitions of ev-degree and ve-degree based versions of some topological indices are the following:

The first ve-degree based Zagreb alpha index is as follows:

$$ZI_1^{\alpha ve}(\mathrm{G}) = \sum_{\nu \in V(\mathrm{G})} (d_{ve}(\nu))^2 \tag{1}$$

The first ve-degree based Zagreb beta index is defined as:

$$ZI_1^{\beta ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} (d_{ve}(\nu_1) + d_{ve}(\nu_2)) \tag{2}$$

The second ve-degree based Zagreb index is given by the formula:

$$ZI_2^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} (d_{ve}(\nu_1) \times d_{ve}(\nu_2)) \tag{3}$$

The ve-degree based Randíc index is as follows:

$$RI^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} (d_{ve}(\nu_1) \times d_{ve}(\nu_2))^{-\frac{1}{2}} \tag{4}$$

The ev-degree based Randíc index is defined as:

$$RI^{ev}(\mathrm{G}) = \sum_{e \in E(\mathrm{G})} d_{ev}(e)^{-\frac{1}{2}} \tag{5}$$

The ve-degree based atom-bond connectivity index is given by the formula:

$$ABCI^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} \sqrt{\frac{d_{ve}(\nu_1) + d_{ve}(\nu_2) - 2}{d_{ve}(\nu_1) \times d_{ve}(\nu_2)}} \tag{6}$$

The ve-degree based geometric-arithmetic index is as follows:

$$GAI^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} \frac{2\sqrt{d_{ve}(\nu_1) \times d_{ve}(\nu_2)}}{d_{ve}(\nu_1) + d_{ve}(\nu_2)} \tag{7}$$

The ve-degree based harmonic index is defined as:

$$HI_1^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} \frac{2}{d_{ve}(\nu_1) + d_{ve}(\nu_2)} \tag{8}$$

The ve-degree based sum-connectivity index is given by the formula:

$$SCI^{ve}(\mathrm{G}) = \sum_{\nu_1\nu_2 \in E(\mathrm{G})} \frac{1}{\sqrt{d_{ve}(\nu_1) + d_{ve}(\nu_2)}} \tag{9}$$

We compute these indices by using the vertex partition strategy, the edge partition techniques, expository strategies, sum of degrees of neighboring techniques, degree checking and combinatorial techniques. We use Matlab and Maple for some calculations and verification purpose.

3 The ev and ve Degree Based Indices

Consider the two dimensional molecular structure of $Si_2C_3-I[a, b]$ as shown in Fig. 1 having b rows and a number of unit cells in each row. Before proceeding further, we include the following tables which will be used to achieve our results. In Table 1, the total number of vertices and edges are given for our molecular structure having b rows and a number of unit cells in each row. The Table 2 gives the partition of vertex set on the basis of degree of vertices.

Table 1: Frequency of vertex and edges of $Si_2C_3-I[a,b]$

Total Vertices	$10ab$
Total Edges	$15ab$-$2a$-$3b$

Table 2: Vertex degree of $Si_2C_3 - I[a,b]$ with corresponding frequency

$d(v)$	Number of vertex
1	2
2	4a+6b-4
3	10ab-4a-6b+2

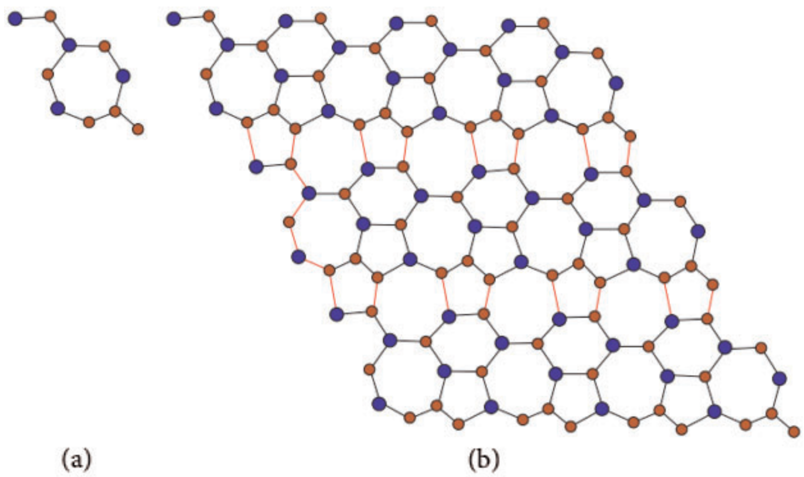

Figure 1: The unit cell and $Si_2C_3 - I$ [3,4], respectively

4 Main Results

- **The ev-degree based Zagreb index**

To compute the ev-degree based Zagreb index of $Si_2C_3 - I[a, b]$, we use ev-degree based edges frequency given in Table 3:

$$ZI^{ev}(Si_2C_3 - I) = \sum_{e \in E(Si_2C_3 - I)} d_{ev}(e)^2$$

$$= 1 \times 3^2 + 1 \times 4^2 + (a + 2b) \times 4^2 + (6a + 8b - 9) \times 5^2$$

$$+ (15ab - 9a - 13b + 7) \times 6^2$$

$$= 540ab - 158a - 236b + 52.$$

Table 3: Number of edges of $Si_2C_3 - I[a, b]$

$(d(v_1), d(v_2))$	Number of edges
(1,2)	1
(1,3)	1
(2,2)	a+2b
(2,3)	6a+8b-9
(3,3)	15ab-9a-13b+7

- **The first ve-degree based Zagreb Alpha index**

To compute the first ve-degree based zagreb alpha index of $Si_2C_3 - I[a, b]$, we use ve-degrees given in Table 4 of vertices partition:

$$
\begin{aligned}
ZI_1^{\alpha ve}(Si_2C_3 - I) &= \sum_{v \in V(Si_2C_3 - I)} d_{ve}(v)^2 \\
&= 1 \times 2^2 + 1 \times 3^2 + 2 \times 4^2 + (2a + 4b - 2) \times 5^2 + (2a + 2b - 4) \times 6^2 \\
&\quad + 1 \times 5^2 + (2a + 2b - 2) \times 7^2 + (2a + 2b - 7) \times 8^2 \\
&\quad + (10ab - 8a - 12b + 10) \times 9^2 \\
&= 810ab - 300a - 446b + 115.
\end{aligned}
$$

Table 4: Ve-degrees of vertices of $Si_2C_3 - I[a,b]$ with corresponding frequency

$d(v)$	v e-degree	Number of vertices
1	2	1
1	3	1
2	4	2
2	5	$2a$+$4b$-2
2	6	$2a$+$2b$-4
3	5	1
3	6	$\begin{cases} 1 \ for \ \ a = 1 \ \ and \ \ b \geq 1 \\ 0 \ for \ \ a > 1 \ \ and \ \ b \geq 1 \end{cases}$
3	7	$\begin{cases} 4b - 4 \ for \ \ a = 1 \ \ and \ \ b \geq 1 \\ 2a + 2b - 2 \ for \ \ a = 1 \ \ and \ \ b \geq 1 \end{cases}$
3	8	$2a$+$4b$-7 for $a =$ 1 and $b \geq$1
3	9	10ab-8a-12b+10 for $a =$ 1 and $b \geq$1

- **The first ve-degree based Zagreb Beta index**

To compute first ve-degree based Zagreb beta index of $Si_2C_3 - I[a, b]$, we use ve-degrees of end vertices of each edge given in Table 5:

$$
\begin{aligned}
ZI_1^{\beta ve}(Si_2C_3 - I) &= \sum_{v_1 v_2 \in E(Si_2C_3 - I)} (d(v_1) + d(v_2)) \\
&= 1 \times 6 + 1 \times 8 + 2 \times 9 + (a + 2b - 2) \times 10 + 1 \times 11 + 1 \times 10 + 1 \times 11 \\
&\quad + (2b + 2) \times 12 + (2a + 2b - 5) \times 13 + (4a + 2b - 7) \times 13 + (2b - 2) \times 14 \\
&\quad + 1 \times 15 + (2a + 2b - 3) \times 16 + (a + 2b - 4) \times 16 + (2a + 4b - 7) \times 17 \\
&\quad + (15ab - 14a - 21b + 20) \times 18 \\
&= 270ab - 82a - 122b + 28.
\end{aligned}
$$

Table 5: Ve-degrees of end vertices of each edge of $Si_2C_3 - I[a, b]$

$(d(v_1),\ d(v_2))$	v e-degree	Number of edges
(1,2)	(2,4)	1
(1,3)	(3,5)	1
(2,2)	(4,5)	2
	(5,5)	a+2b-2
(2,3)	(4,6)	$\begin{cases} 1 \ for \ a=1 \ and \ b \geq 1 \\ 0 \ for \ a>1 \ and \ b \geq 1 \end{cases}$
	(4,7)	$\begin{cases} 1 \ for \ a=1 \ and \ b \geq 1 \\ 0 \ for \ a>1 \ and \ b \geq 1 \end{cases}$
	(5,5)	$\begin{cases} 2 \ for \ a=1 \ and \ b \geq 1 \\ 1 \ for \ a>1 \ and \ b \geq 1 \end{cases}$
	(5,6)	$\begin{cases} 2 \ for \ a=1 \ and \ b \geq 1 \\ 1 \ for \ a>1 \ and \ b \geq 1 \end{cases}$
	(5,7)	$\begin{cases} 0 \ for \ a, \ b=1 \\ 4b-4 \ for \ a=1 \ and \ b>1 \\ 2b+2 \ for \ a, \ b>1 \end{cases}$
	(5,8)	$2a+2b-5 \ for \ a, \ b>1$
	(6,7)	$\begin{cases} 0 \ for \ a, \ b=1 \\ 4b-4 \ for \ a=1 \ and \ b>1 \\ 4a+2b-7 \ for \ a, \ b>1 \end{cases}$
	(6,8)	$\begin{cases} 2b-2 \ for \ a>1 \\ 0 \ for \ a=1 \end{cases}$
(3,3)	(7,7)	$\begin{cases} 0 \ for \ a>1 \\ 2b-2 \ for \ a=1 \end{cases}$
	(7,8)	$\begin{cases} 1 \ for \ a>1 \\ 0 \ for \ a=1 \end{cases}$
	(7,9)	$\begin{cases} 2a+2b-3 \ for \ a>1 \\ 0 \ for \ a=1 \end{cases}$
	(8,8)	$a+2b-4 \ for \ a>1$
	(8,9)	$2a+4b-7 \ for \ a>1$
	(9,9)	$15ab-14a-21b+20 \ for \ a>1$

- **The second ve-degree based Zagreb index**

To compute the second ve-degree based Zagreb index of $Si_2C_3 - I[a, b]$, we use ve-degrees of end vertices of each edge given in Table 5:

$$ZI_2^{ve}(Si_2C_3 - I) = \sum_{v_1 v_2 \in E(Si_2C_3 - I)} (d(v_1) \times d(v_2))$$

$$= 1 \times 8 + 1 \times 15 + 2 \times 20 + (a + 2b - 2) \times 25 + 1 \times 28 + 1 \times 25 + 1 \times 30$$

$$
\begin{aligned}
&+(2b+2)\times 35+(2a+2b-5)\times 40+(4a+2b-7)\times 42+(2b-2)\times 48\\
&+1\times 56+(2a+2b-3)\times 63+(a+2b-4)\times 64+(2a+4b-7)\times 72\\
&+(15ab-14a-21b+20)\times 81\\
&=1215ab-527a-779b+303.
\end{aligned}
$$

- **The ve-degree based Randíc index**

To compute the ve-degree based Randíc index of $Si_2C_3-I[a,\ b]$, we use ve-degrees of end vertices of each edge with corresponding frequency as given in Table 5:

$$
\begin{aligned}
RI^{ve}\left(Si_2C_3-I\right) &= \sum_{v_1v_2\in E(Si_2C_3-I)} \left(d\left(v_1\right)\times d\left(v_2\right)\right)^{-\frac{1}{2}}\\
&=1\times(8)^{-\frac{1}{2}}+1\times(15)^{-\frac{1}{2}}+2\times(20)^{-\frac{1}{2}}+(a+2b-2)\times(25)^{-\frac{1}{2}}+1\times(28)^{-\frac{1}{2}}\\
&+1\times(25)^{-\frac{1}{2}}+1\times(30)^{-\frac{1}{2}}+(2q+2)\times(35)^{-\frac{1}{2}}+(2a+2b-5)\times(40)^{-\frac{1}{2}}\\
&+(4a+2b-7)\times(42)^{-\frac{1}{2}}+(2b-2)\times(48)^{-\frac{1}{2}}+1\times(56)^{-\frac{1}{2}}+(2a+2b-3)\\
&\times(63)^{-\frac{1}{2}}+(a+2b-4)\times(64)^{-\frac{1}{2}}+(2a+4b-7)\times(72)^{-\frac{1}{2}}\\
&+(15ab-14a-21b+20)\times(81)^{-\frac{1}{2}}\\
&=\frac{5}{3}ab+a\left(\frac{1}{\sqrt{10}}+\frac{4}{\sqrt{42}}+\frac{2}{3\sqrt{7}}+\frac{1}{3\sqrt{2}}-\frac{443}{360}\right)\\
&+b\left(\frac{2}{\sqrt{35}}+\frac{1}{\sqrt{10}}+\frac{2}{\sqrt{42}}+\frac{1}{2\sqrt{3}}\right.\\
&\left.+\frac{2}{3\sqrt{7}}+\frac{1}{3\sqrt{2}}+\frac{5}{12}+\left(\frac{1}{2\sqrt{2}}+\frac{1}{\sqrt{15}}+\frac{1}{\sqrt{5}}\right.\right.\\
&\left.+\frac{1}{2\sqrt{7}}+\frac{1}{\sqrt{30}}+\frac{2}{\sqrt{35}}\right).
\end{aligned}
$$

- **The ev-degree based Randíc index**

To compute the ev-degree based Randíc index of $Si_2C_3-I[a,\ b]$, we use ev-degree based edge partition with corresponding frequency given in Table 6:

$$
\begin{aligned}
RI^{ev}\left(Si_2C_3-I\right) &= \sum_{e\in E(Si_2C_3-I)} d_{ev}\left(e\right)^{-\frac{1}{2}}\\
&=1\times(3)^{-\frac{1}{2}}+1\times(4)^{-\frac{1}{2}}+(a+2b)\times(4)^{-\frac{1}{2}}+(6a+8b-9)\times(5)^{-\frac{1}{2}}\\
&+(15ab-9a-13b+7)\times(6)^{-\frac{1}{2}}\\
&=\frac{15}{\sqrt{6}}ab+a\left(\frac{1}{2}+\frac{6}{\sqrt{5}}-\frac{9}{\sqrt{6}}\right)+b\left(1+\frac{8}{\sqrt{5}}-\frac{13}{\sqrt{6}}\right)+\left(\frac{1}{2}+\frac{1}{\sqrt{3}}+\frac{7}{\sqrt{6}}-\frac{9}{\sqrt{5}}\right).
\end{aligned}
$$

Table 6: Frequency of edges with ev-degrees of $Si_2C_3 - I[a, b]$

$(d(v_1), d(v_2))$	ev-degree	Number of edges
(1,2)	3	1
(1,3)	4	1
(2,2)	4	a+2b
(2,3)	5	6a+8b-9
(3,3)	6	15ab-9a-13b+7

- **The ve-degree based atom-bond connectivity index**

To compute the ve-degree based atom-bond connectivity index of $Si_2C_3 - I[a, b]$, we use ve-degrees of end vertices of each edge with corresponding frequency as given in Table 5:

$$\begin{aligned}
ABCI^{ve}(Si_2C_3 - I) &= \sum_{v_1v_2 \in E(Si_2C_3 - I)} \sqrt{\frac{d_{ve}(v_1) + d_{ve}(v_2) - 2}{d_{ve}(v_1) \times d_{ve}(v_2)}} \\
&= 1 \times \sqrt{\frac{4}{8}} + 1 \times \sqrt{\frac{6}{15}} + 2 \times \sqrt{\frac{7}{20}} + (a + 2b - 2) \times \sqrt{\frac{8}{25}} + 1 \times \sqrt{\frac{9}{28}} \\
&\quad + 1 \times \sqrt{\frac{8}{25}} + 1 \times \sqrt{\frac{9}{30}} + (2b + 2) \times \sqrt{\frac{10}{35}} + (2a + 2b - 5) \times \sqrt{\frac{11}{40}} \\
&\quad + (4a + 2b - 7) \times \sqrt{\frac{11}{42}} + (2b - 2) \times \sqrt{\frac{12}{48}} + 1 \times \sqrt{\frac{13}{56}} + (2a + 2b - 3) \\
&\quad \times \sqrt{\frac{14}{63}} + (a + 2b - 4) \times \sqrt{\frac{14}{64}} + (2a + 4b - 7) \times \sqrt{\frac{15}{72}} \\
&\quad + (15ab - 14a - 21b + 20) \times \sqrt{\frac{16}{81}} \\
&= \frac{20}{3}ab + a\left(\sqrt{\frac{11}{10}} + 2\sqrt{\frac{11}{7}} + 2\frac{\sqrt{2}}{3} + \frac{\sqrt{14}}{8} + \frac{\sqrt{15}}{3\sqrt{2}} - \frac{16}{9}\right) \\
&\quad + b\left(\sqrt{\frac{11}{10}} + \sqrt{\frac{11}{7}} + \frac{2\sqrt{2}}{3} + \frac{\sqrt{14}}{4} - \frac{25}{3}\right) \\
&\quad + \left(\frac{2\sqrt{2}}{\sqrt{7}} + \frac{\sqrt{13}}{2\sqrt{14}} - \sqrt{2} - \frac{\sqrt{14}}{2} + \frac{11\sqrt{15}}{6\sqrt{2}} + \frac{71}{9}\right).
\end{aligned}$$

- **The ve-degree based geometric-arithmetic index**

To compute the ve-degree based geometric-arithmetic index of $Si_2C_3 - I[a, b]$, we use ve-degrees of end vertices of each edge with corresponding frequency as given in Table 5:

$$GAI^{ve}(Si_2C_3 - I) = \sum_{v_1v_2 \in E(Si_2C_3 - I)} \frac{2\sqrt{d_{ve}(v_1) \times d_{ve}(v_2)}}{d_{ve}(v_1) + d_{ve}(v_2)}$$

$$= 1 \times \frac{2\sqrt{8}}{6} + 1 \times \frac{2\sqrt{15}}{8} + 2 \times \frac{2\sqrt{20}}{9} + (a + 2b - 2) \times \frac{2\sqrt{25}}{10} + 1 \times \frac{2\sqrt{28}}{11}$$

$$+ 1 \times \frac{2\sqrt{25}}{10} + 1 \times \frac{2\sqrt{30}}{11} + (2q + 2) \times \frac{2\sqrt{35}}{12} + (2a + 2b - 5) \times \frac{2\sqrt{40}}{13}$$

$$+ (4a + 2b - 7) \times \frac{2\sqrt{42}}{13} + (2b - 2) \times \frac{2\sqrt{48}}{14} + 1 \times \frac{2\sqrt{56}}{15} + (2a + 2b - 3)$$

$$\times \frac{2\sqrt{63}}{16} + (a + 2b - 4) \times \frac{2\sqrt{64}}{16} + (2a + 4b - 7) \times \frac{2\sqrt{72}}{17}$$

$$+ (15ab - 14a - 21b + 20) \times \frac{2\sqrt{81}}{18}$$

$$= 15ab + a\left(\frac{8\sqrt{10}}{13} + \frac{8\sqrt{3}}{7} + \frac{3\sqrt{7}}{4} - 12\right) + b\left(\frac{\sqrt{35}}{3} + \frac{8\sqrt{10}}{13} + \frac{3\sqrt{7}}{4}\right.$$

$$\left. + \frac{48\sqrt{2}}{17} - 17\right) + \left(\frac{41\sqrt{15}}{36} - \frac{218\sqrt{2}}{51} - \frac{67\sqrt{7}}{88} + \frac{2\sqrt{30}}{11} + \frac{\sqrt{35}}{3}\right.$$

$$\left. - \frac{20\sqrt{10}}{3} - \frac{8\sqrt{3}}{7} + \frac{4\sqrt{14}}{15} - 25\right).$$

- **The ve-degree based harmonic index**

To compute the ve-degree based harmonic index of $Si_2C_3 - I[a, b]$, we use ve-degrees of end vertices of each edge with corresponding frequency as given in Table 5:

$$HI_1^{ve}(Si_2C_3 - I) = \sum_{v_1v_2 \in E(Si_2C_3 - I)} \frac{2}{d_{ve}(v_1) + d_{ve}(v_2)}$$

$$= 1 \times \frac{2}{6} + 1 \times \frac{2}{8} + 2 \times \frac{2}{9} + (a + 2b - 2) \times \frac{2}{10} + 1 \times \frac{2}{11} + 1 \times \frac{2}{10} + 1 \times \frac{2}{11}$$

$$+ (2b + 2) \times \frac{2}{12} + (2a + 2b - 5) \times \frac{2}{13} + (4a + 2b - 7) \times \frac{2}{13} + (2b - 2) \times \frac{2}{14}$$

$$+ 1 \times \frac{2}{15} + (2a + 2b - 3) \times \frac{2}{16} + (a + 2b - 4) \times \frac{2}{16} + (2p + 4q - 7) \times \frac{2}{17}$$

$$
\begin{aligned}
&+(15pq-14p-21q+20)\times\frac{2}{18}\\
&=\frac{5}{3}ab+\frac{14147}{79560}a+\frac{4203}{15470}b+\frac{305727}{6126120}.
\end{aligned}
$$

- **The ve-degree based sum-connectivity index**

To compute the ve-degree based sum-connectivity index of $Si_2C_3-I[a,\,b]$, we use ve-degrees of end vertices of each edge with corresponding frequency as given in Table 5:

$$
\begin{aligned}
SCI^{ve}(Si_2C_3-I) &= \sum_{v_1v_2\in E(Si_2C_3-I)}\frac{1}{\sqrt{d_{ve}(v_1)+d_{ve}(v_2)}}\\
&=1\times\frac{1}{\sqrt{6}}+1\times\frac{1}{\sqrt{8}}+2\times\frac{}{\sqrt{9}}+(a+2b-2)\times\frac{1}{\sqrt{10}}+1\times\frac{1}{\sqrt{11}}+1\\
&\quad\times\frac{1}{\sqrt{10}}+1\times\frac{1}{\sqrt{11}}+(2b+2)\times\frac{1}{\sqrt{12}}+(2a+2b-5)\times\frac{1}{\sqrt{13}}+(4a+2b-7)\\
&\quad\times\frac{1}{\sqrt{13}}+(2b-2)\times\frac{1}{\sqrt{14}}+1\times\frac{1}{\sqrt{15}}+(2a+2b-3)\times\frac{1}{\sqrt{16}}\\
&\quad+(a+2b-4)\times\frac{1}{\sqrt{16}}+(2a+4b-7)\times\frac{1}{\sqrt{17}}\\
&\quad+(15ab-14a-21b+20)\times\frac{1}{\sqrt{18}}\\
&=\frac{5}{6}ab+a\left(\frac{1}{\sqrt{10}}+\frac{2}{\sqrt{13}}+\frac{2}{\sqrt{17}}+\frac{23}{36}\right)+b\left(\frac{2}{\sqrt{10}}+\frac{1}{\sqrt{3}}+\frac{2}{\sqrt{13}}+\frac{4}{\sqrt{17}}-\frac{1}{6}\right)\\
&\quad+\left(\frac{1}{\sqrt{6}}+\frac{1}{2\sqrt{2}}-\frac{2}{\sqrt{10}}+\frac{2}{\sqrt{11}}+\frac{1}{\sqrt{3}}-\frac{5}{\sqrt{13}}-\frac{7}{\sqrt{17}}+1\right).
\end{aligned}
$$

5 Graphical Analysis

In this section, we present the graphical analysis of the computed topological indices for $Si_2C_3-I[a,b]$, see Figs. 2–6 which indicate that, numerical values of these descriptors increase with the increment of a and b in the given molecular structure.

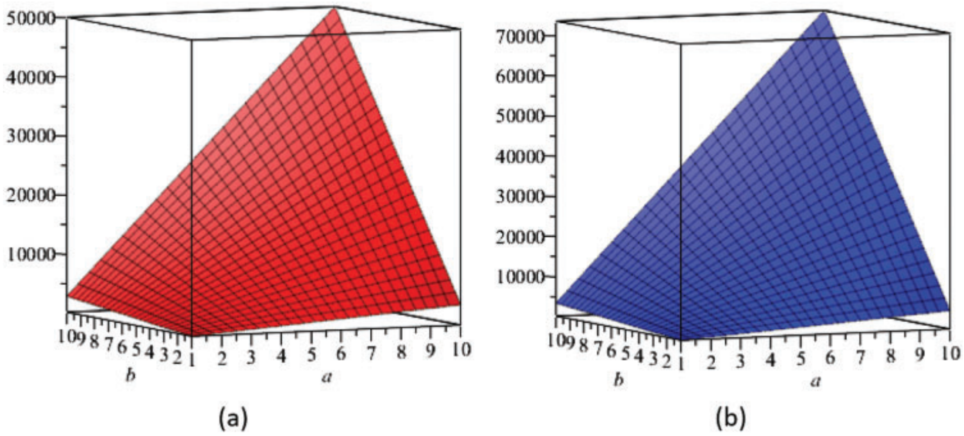

Figure 2: (a) The ev-degree based Zagreb index, (b) The first ve-degree based Zagreb α index

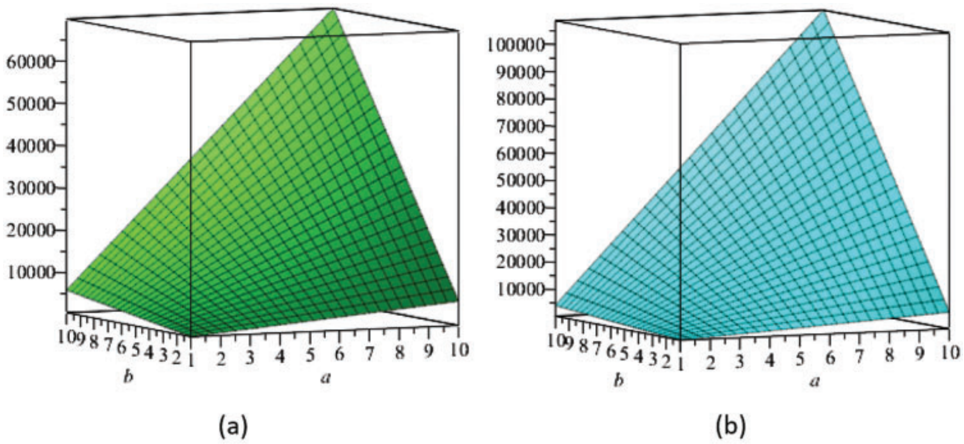

Figure 3: (a) The first ve-degree based Zagreb β index, (b) The second ve-degree based Zagreb index

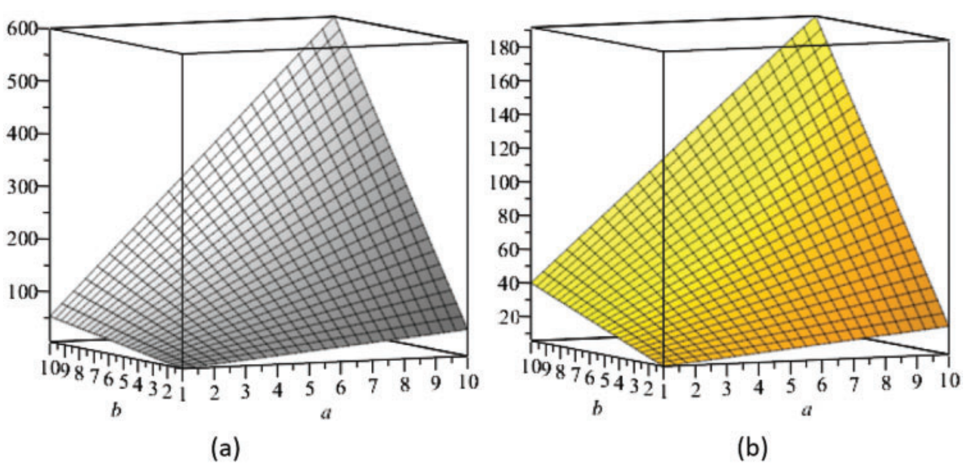

Figure 4: (a) The ev-degree based Randíc index, (b) The ve-degree based Randíc index

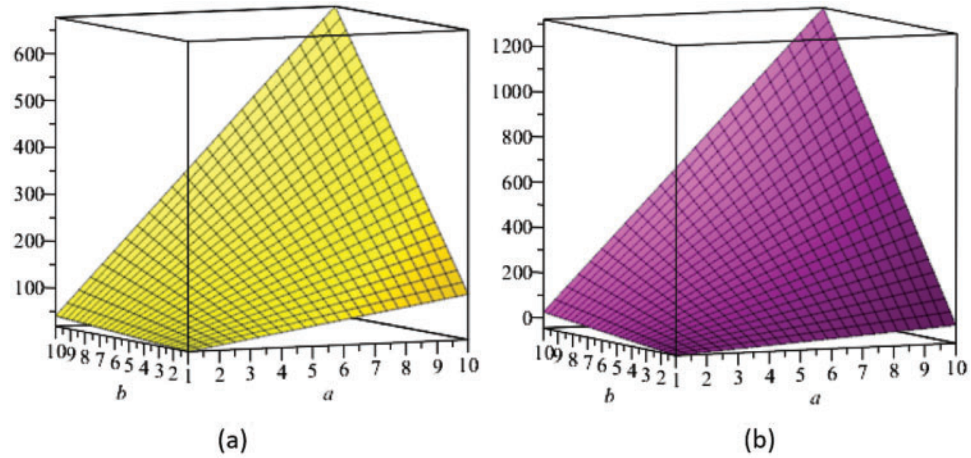

Figure 5: (a) The ve-degree based atomic-connectivity index, (b) The ve-degree based geometric-arithmetic index

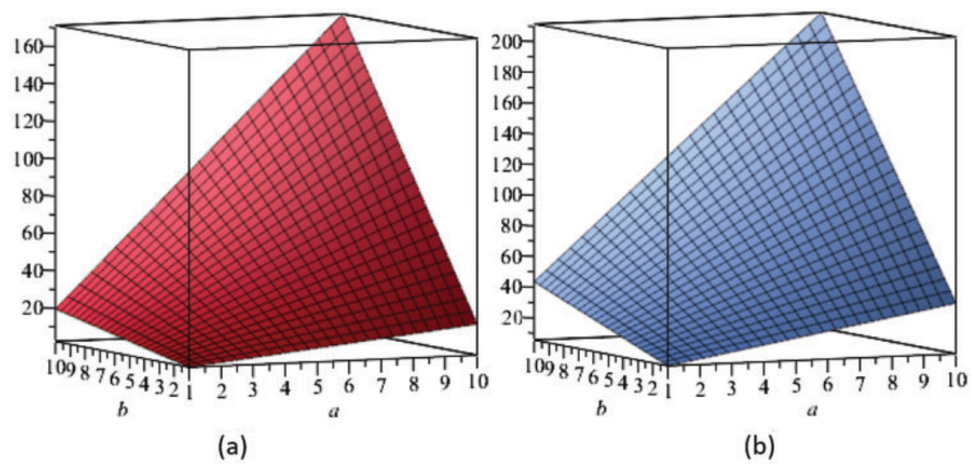

Figure 6: (a) The ve-degree based harmonic index, (b) The ve-degree based sum-connectivity index

6 Conclusion

In this article, we have provided results related to the ve-degree Zagreb alpha index, first ve-degree Zagreb beta index, second ve-degree Zagreb index, ve-degree Randíc index, ev-degree Randíc index, ve-degree atom-bond connectivity index, ve-degree geometric-arithmetic index, ve-degree harmonic index and ve-degree sum-connectivity index for the two dimensional molecular structure of $Si_2C_3 - I[a,b]$. Secondly, we have presented the graphical analysis of the obtained results. At the end, under some assumptions, the comparison among the values of the computed indices has been shown through graphs, see Fig. 7.

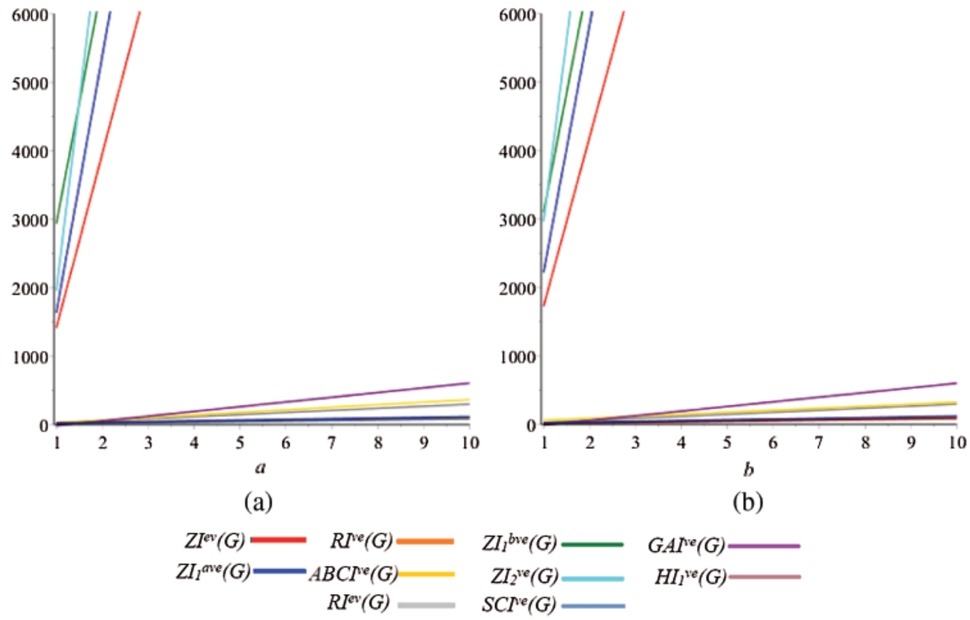

Figure 7: Comparison of indices by keeping one parameter fixed

The Fig. 7 shows that, generally, there are two types of the trends in the out put of the formulae of these indices. The values of the some indices increase rapidly, whereas other values does not show rapid increase. Due to strong prediction ability of ev-degree and ve-degree based topological indices, our results and analysis have potential to play vital role in study of Silicon carbides.

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