*International Journal of Research in Engineering and Science (IJRES)*
*ISSN (Online): 2320-9364, ISSN (Print): 2320-9356*
*www.ijres.org Volume 10 Issue 11 ǁ November 2022 ǁ PP. 283-286*

# Electrochemical studies on carbon based waste byproducts and its application as an additive in Bitumen

Kiran K, Dr.Lathakumariand Dr.Priya V
*Department Of Civil Engineering*
*B M S College Of Engineering*
*Bengaluru-560019, Karnataka, India.*

***Abstract-****The rapid industrialization produces large quantity of different industrial by products. Different industries generate different quantity and quality of industrial waste by products. Therefore, the need of the hour is that the industrial waste by products generated should be used in an ecofriendly manner to achieve sustainable development and to reduce the burden of fresh raw materials produced by the nature.*
*Carbon waste is one such industrial waste produced in various industrial processes. The quantity and form of carbon waste generated varies with the type of industries. The carbon exists in various forms in the nature. It has been found that each form of carbon has some particular application. There is a scope for commingled form of carbon waste obtained from the industries. In this study, different forms of carbon are first converted to single uniform form or mono form and then it is proposed to investigate the application of carbon black as an additive in bitumen.*
*The purpose of this study is to collect carbon waste by products from different industries. The structure, morphology and electrochemical performance of carbon waste by products are determined by conducting SEM, XRD, EDS and cyclic voltammetry test and the probable scope of its usage in construction and as an additive in bitumen are explored.*
***Keywords- Carbon waste; SEM; XRD;EDS; Bitumen.***

---

Date of Submission: 14-11-2022 Date of acceptance: 28-11-2022

---

## I. INTRODUCTION

The growth in different kinds of industries together with population growth has resulted in a huge increase in production of various kinds of waste materials, throughout the world. The creation and disposal of non-decaying waste materials such as Blast Furnace Slag, Fly-Ash, Steel Slag, Scrap Tyres, Plastics, Electronic Wastes etc. have been posing difficult problems in developed as well as in developing countries. Research works are carried out by various countries for the disposal of some of these waste products and utilization of some other products and there is a lot of published literature dealing with different aspects of these challenging problems. Of these, the efforts to find useful applications of some of the waste products as an additive to modify bitumen have given satisfactory results.

Carbon black is virtually pure carbon in the form of colloidal particles resulting from the incomplete thermal decomposition of hydrocarbons. Different analytical methods used for the study of various structural parameters of both the samples include X-ray diffraction, scanning electron microscopy.

## II. Materials And Methodology

Carbon black is effectively pure carbon which is formed by incomplete burning/thermolysis the compounds made up of hydrogen and carbon. The appearance of carbon black is black, fine powder. It is an unwanted material obtained from various industries and hence it is difficult to dispose. Normally these wastes from industries are decomposed in the soil thereby causing soil contamination and pollution in water. By utilizing carbon black as filler, this problem can be reduced to a high degree. The specific gravity of carbon black is 1.33. The pH of carbon black is 6, hence is an inert material.

The fine powdery soot or carbon waste formed by the burning of hydro carbon under oxygen depleted conditions. And also, carbon black is defined as virtually pure elemental carbon in form of colloidal particles that are produced by incomplete combustion or thermal decomposition of gaseous or liquid hydro carbon under controlled conditions. And also Carbon black powder which is produced from source of burnt plastic waste or tyres.

The morphological features of carbon waste were analyzed by SEM, EDS, and XRD. The surface morphology and EDS measurements were recorded with scanning electron microscope.

*Surface Morphological Study*

The surface morphology of carbon waste is analysed using SEM and the carbon waste is seen to be non-uniform. It is evident from the figure that the carbon waste particles are in the form of spherical particles of a wide range of sizes. The larger particles seem to be made up of aggregates of the smaller ones. The carbon waste particles are small with majority of particles about 2 µm diameter.

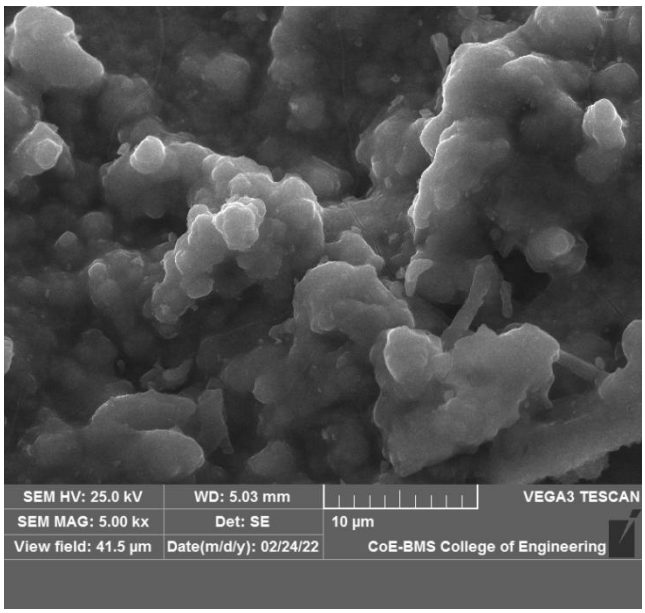


Fig.1: SEM image of Carbon byproduct

*Chemical Composition Analysis*

Energy dispersive spectroscopy (EDS) of carbon waste particles is presented in figure. The spectra show the presence of carbon, oxygen and some traces of iron. The composition of the carbon waste from the EDS analysis indicates the waste to consist of about 22.08% weight carbon, 37.03% weight of oxygen and 40.89% weight of iron. Iron is due to the use of iron oxide in the brick manufacturing process.

The result shows the carbon waste to be composed mainly of carbon and oxygen, figure 2 and table 1. The Energy Dispersive Spectroscopy (EDS) of the soot particles indicate the presence of iron other metal along with carbon and oxygen as recorded in the spectra.

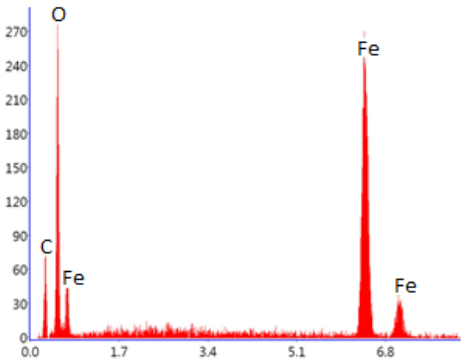


Fig.3: EDS spectra of Carbon waste

*STRUCTURAL CHARACTERISATION*

Figure 4.11 displays the X-ray diffraction (XRD) pattern of carbon waste from a brick manufacturing. The collected carbon waste was purified using a vacuum filtration equipment before being put to use. At $2\theta = 26.36^{o}$, the Bragg diffraction peaks. The hexagonal graphite lattice corresponds to the peak at $2\theta = 26.36^{o}$. The peak at $2\theta = 26.36^{o}$ is a narrow peak of moderately high intensity that denotes the presence of significant amorphous carbon material.

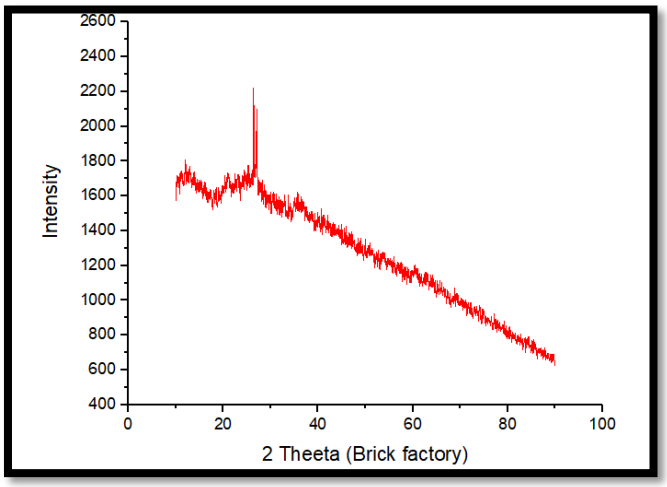


Fig.2: XRD of Carbon byproduct

*CARBON WASTE AS AN ADDITIVE IN BITUMEN*

In this study, we talk about how carbon black powder works well as an additive in VG-10 bitumen. Tests were carried out to determine the basic characteristics changes in bitumen after the addition of carbon black powder in various percentages, including 0.5%, 1.0%, 1.5%, and 2.0% for all the varied percentage additions of carbon black to the bitumen. Here, the viscosity and softening point temperature changes are observed.

Via melt blending, carbon black modified bitumen binder was made. The neat bitumen binder was heated up until the temperature of it reached to 150°C and then mixed neat bitumen binder with different percentages of carbon black (0.5%, 1%, 1.5% and 2%), employing a shear mixer at a speed of 3000 r/min. Adding 1/3 mass of carbon black into the asphalt every 10 min, then mixing for 30 min after all carbon black was added, so the whole mixing time was 1h to prepare CB modified bitumen, and referring to previous researches, evenly distributed carbon black modified bitumen can be obtained.

*BASIC PROPERTIES OF VIRGIN BITUMEN BINDER*

The virgin bitumen also had been tested in penetration and softening point to check its repeatability. The results are as in the following table.

**TABLE I**

(Basic properties ofvirginbitumen binder)

| SL NO | TESTS | VG-10 |
|---|---|---|
| 1 | Penetration at 25ºC, 5 sec | 99 |
| 2 | Softening point, ºC | 43.5 |
| 3 | Viscosity, sec | 100.66 |
| 4 | Ductility at 25ºC | 78 |
| 5 | Specific gravity | 0.961 |

*BASIC PROPERTIES AFTER ADDITION OF CB POWDER*

After the mixing work was completed, the entire sample was tested for its penetration value, softening point value, specific gravity, ductility and viscosity. The results are shown in the tables below.

TABLE II

(Basic properties after addition of CB powder)

| Tests<br>% of CB | Specifcgravity | Softening point in ºC | Viscosity in sec | Penetration in mm | Ductility in cm |
|---|---|---|---|---|---|
| Virgin bitumen | 0.961 | 43.5 | 100.66 | 99 | 76 |
| 0.5 | 0.971 | 45 | 99 | 94 | 69 |
| 1.0 | 0.979 | 45.5 | 97 | 93 | 63 |
| 1.5 | 0.996 | 46 | 95 | 89 | 57 |
| 2.0 | 1.12 | 50 | 84 | 83 | 44 |

## III. CONCLUSION

After detailed experimental investigation, the following conclusions are drawn

- Different carbon waste samples have been found to have non-uniform surface morphology.
- The EDS analysis reveals the inclusion of additional undesirable components in the sample.
- By using centrifugation and vacuum filtering, the undesirable components are eliminated.
- Successful addition and blending of the virgin bitumen and carbon black at the appropriate ratios.
- After carbon black is added, the bitumen's characteristics are established.

Both the penetration and softening point tests have shown that adding carbon black additives improves the values more than using virgin bitumen alone. As a result, bitumen's resistance to rutting and cracking is increased by the use of carbon black additives.

### ACKNOWLEDGMENT

The authors would like to thank the faculty and staff of Department of Civil Engineering, Department of Physics, Department of Chemistry and Department of Mechanical Engineering, B.M.S. College of Engineering who in spite of being extraordinarily busy with their duties, took time out to hear, guide and keep me on the correct path allowing me to carry out my project by extending their support during my project work.

## REFERENCES

[1]. "Carbon footprint in Higher Education Institutions: a literature review and prospects for future research"Karen Valls-Val & María D. Bovea, Springer, 2021.
[2]. "Carbon-allotropes: synthesis methods, applications and future perspectives" P. S. Karthik, A. L. Himaja and Surya Prakash Singh, Carbon letters, 2014.
[3]. "Carbon-Based Nanomaterials/Allotropes: A Glimpse of Their Synthesis, Properties and Some Applications" SalisuNasir 1,2,* ID , MohdZobir Hussein 1,* ID , ZulkarnainZainal 3 and Nor AzahYusof, Materials, 2018.
[4]. "Morphological characterization of soot from the atmospheric combustion of kerosene" Ezekiel dixondikio. e-journal of chemistry, 8(3), 1068-1073, 2011.
[5]. "Structural Characterization of Paraffin Wax Soot and Carbon Black by XRD" Anu N. mohan, B. Manoj, Jerin john and A.V. Ramya. Asian Journal of Chemistry, Vol. 25, Supplementary Issue (2013), S76-S78, 2013.
[6]. "Morphological characterization of soot from the combustion of candle wax davidntaoteshooto" Ezekiel Dixon Dikio. International Journal of electrochemical science, 6, 1269 – 1276, 2011.
[7]. "Synthesis of biodiesel from waste vegetable oil with large amounts of free fatty acids using a carbon-based solid acid catalyst" Qing Shu, JixianGao, Zeeshan Nawaz, Yuhui Liao, Dezheng Wang, Jinfu Wang. Applied Energy Journal, 87 (2010) 2589–2596, 2010.
[8]. "Color removal from wastewater using low-cost activated carbon derived from agricultural waste material" Kunwar P. Singh, Dinesh Mohan, SaritaSinha, G. S. Tondon, and Devlina Gosh. Environmental Chemistry Division, Industrial Toxicology Research Centre, Vol. 42, No. 9, 2003.
[9]. "Characteristic, structure and morphology of carbon deposit from biodiesel blend" J.A.Hidayat, BambangSugiarto. Evergreen Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy, Vol. 07, Issue 04, pp609-614, December 2020.
[10]. "Study on properties of BC mix by adding carbon black powder and e-waste" Mrs. DhanushaTammara, Madhu O, Abhishek V B, Ranjith S, Nagamani T N, Ayyana Gouda L. International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 04 | Apr 2019.
[11]. "A study on use of carbon black powder in bituminous road construction" Saritha N. International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181 IJERTV4IS060220, vol. 4 issue 06, June-2015.