International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

# CIVIL ENGINEERING-AS AN INTER-DISCIPLINARY APPROACH

**Soumita Mondal[1], Honey Gaur[2]**

*[1]M.Tech Scholar, Civil Engineering Department, Kalinga University, Atal Nagar, Naya Raipur, (C.G)*
*[2]Assistant Professor Civil Engineering Department, Kalinga University, Atal Nagar, Naya Raipur, (C.G)*

---

**Abstract –** *Knowledge is a whole concept as it is related and dependent to many a disciplines either directly or indirectly. From this, the concept of Inter-disciplinary concept has been emerged. Many inter- disciplinary subjects gradually emerged as a separate and independent subjects like Bio-physics, Bio-Chemistry etc. Like that civil engineering is also related with so many subjects like Mathematics, Geometry, Chemistry etc. This paper presents the Inter-disciplinary approach among Civil Engineering, Chemical engineering and Environmental engineering. With the advancement of human civilization, man has become much more aware and conscious of environment and to check the harmful elements contaminating the global environment. Some parts of pollutions are due to chemical substances while utilizing in the civil works like roads and highways, building construction. In this paper, to get a perfect idea, some experiments done on Zeolite concrete block presented to show how it is absorbing $CO_2$ from atmosphere to reduce pollution.*

## 1. INTRODUCTION :

A scientific study requires the co-relative enquiries into different subjects and disciplines attached to it directly or indirectly. Civil engineering is such a field of study which is related to so many disciplines. The present study confined itself i.e. Civil engineering in relation with Chemical engineering and the Environmental engineering in order to provide sustainable development and sustainable Environment. (1)Modern Civil engineering is the outcome of long evolutionary changes, modification and scientific investigation. John Smeaton –the father of modern civil engineering discipline, was engaged in designing bridges, canals, harbours and light houses. He linked with the knowledge of hydrology, soils, environment and other fields .In 1818, the Institute of Civil Engineering was found in London, before this the constructional works like Pyramids in Egypt, Roman colosseum etc. were done by artisans, masons and labours but their knowledge were not less than modern engineers. (2)On the other hand, Chemistry lies its origin in the nomenclature of Alchemy, but Robert Boyle (1661) separated chemistry from Alchemy. As a scientific discipline, it involves with the elements and compounds of atoms, molecules, their composition, structure, chemical properties etc. (3) Now Environmental chemistry involves the study the common modes of pollution in the air, water, soils, ozone layers etc. which also come into the arena of civil engineering .Now the focus has given on how the three aforesaid disciplines are interrelated and interdependent both in positive and negative way.

This paper is going to discuss about the co2, so2, GHG emission from civil works such as openly burning of bitumen emits co2, acid rains, and pollutions from cement industry. There are some gaseous pollutants which affects the existing buildings, monuments, marble palaces such as the Tajmahal, Qutabminar, Charminar gate etc. Acid rains are fading the colours of monuments and buildings. On the other hand, from the viewpoint of civil engineering, in case of cement manufacturing, cement clinker is cooled and grind in the tube mill where 2% to 3% gypsum is added. Approximately 50% co2 emission are from calcinations process of cement,40% co2 emission from other sources indirectly as such from running machines or equipments, transportation etc.

$$3\,CaCo_3 + Sio_2 \xrightarrow{heat} Ca_3SiO_5 + 3CO_2$$

### 1.1 Objective of the study:

1. To find out the steps for achieving environmental sustainability and to highlight the inter-disciplinary efforts for sustainable environment.

2. To explore the inter-relationship and inter-dependence among civil engineering, chemistry and environmental studies

3. To assess how such inter-disciplinary approach will be helpful for environmental sustainability.

4.How to reduce of co2,so2 and GHG gases and other harmful pollution from the air and reducing co2,so2 from the cement manufacturing process and concrete mixture.

5. To provide a Pollution-free and green environment for future generation and sustainable environment by using renewable energy and resources

### 1.2 Cement Composition:

| INGRIDIENTS | RANGE |
|---|---|
| Lime $Ca(OH)_2$ | 62-65% |
| Silica($SiO_2$) | 17-25% |
| Alumina($Al_2O_3$) | 3—8% |
| Iron oxide ($Fe_2O_3$) | 3-5% |
| Calcium Sulphate ($CaSO_4$) | 1-4% |
| Magnesia (MgO) | 1—3% |
| Sulpher (S) | 1—3% |

**Table-1**

It is interesting to note that the materials are related to chemical composition i.e.it is also discussed in the pollution of environments and how to reduce the global warming, $SO_2$, $CO_2$ emission as well as to reduce the corrosion of civil structures by using recycling agents, chemicals etc. and to sustain the health of environment. So as an inter-disciplinary approach Civil engineering, chemical engineering and Environmental engineering are presented for consideration and explained how these are inter-depended and can work together.

## 2. DIAGRAM AND PICTURES:

### 2.1 Cement Manufacturing Process In Diagram:

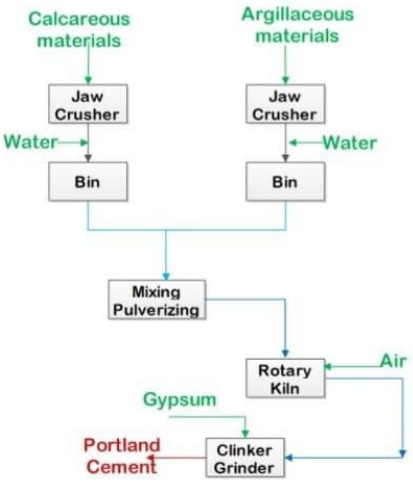


**Diagram-1 Cement Manufacturing Process**

### 2.2 Acid Rain:

The Acid Rain occurs when sulpher-dioxide and nitrogen oxides from the burning of fossil fuels such as petrol, diesel and coal combine with water vapor in the atmosphere and falls to the earth in the form of rain, snow, hail, fog ,frost or dew. Once it reaches, the acidity in the substance can harm and even destroy both natural ecosystems and man-made products.

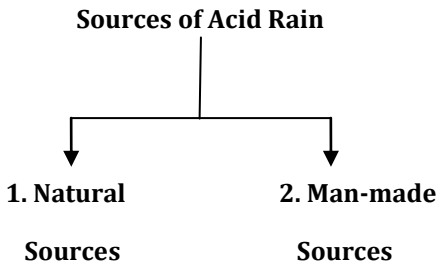


**Diagram-2**

### 2.2.1. Chemical Reaction of Acid Rain:

The primary pollutants $SO_2$ undergoes further reaction in sunlight to form $SO_3$ (sulpher trioxide) which is called secondary pollutants. $SO_3$ reacts with moisture to form sulphuric acid.

$$SO_2 + O_2 \longrightarrow SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

The oxidation of $SO_2$ is most widespread in clouds and particularly in greatly polluted air where there are abundant amounts of ammonia and ozone, which act as catalysts in the formation of sulphuric acid from sulpher dioxide. The second process includes procedure involving nitrogen oxide which nitrogen oxides (NO) reacts with oxygen in the ambient air to form $NO_2$ and $NO_2$ gets converted to nitric acid in presence of water.

$$NO + O_2 \rightarrow NO_2$$

$$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$$

Steel, iron, crude oil processing , automobiles, fossil fuels, smoke and gases has also a contribution to form acid rain.

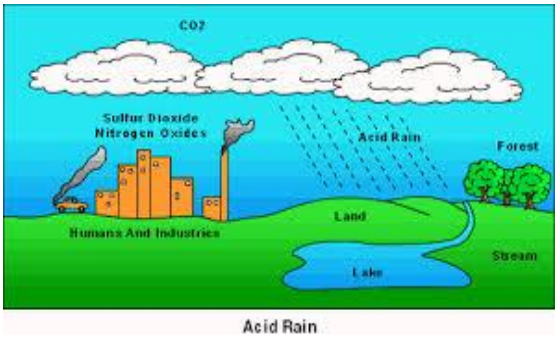


**Fig-1 Acid Rain**

### 2.2.2. Effects of Acid Rain:

i. Effect on trees and plants community.

ii. Effects on aquatic life.

iii. Effects on land and soil.

iv. Effects on monuments and buildings.

### 2.3. Temperature Changing:

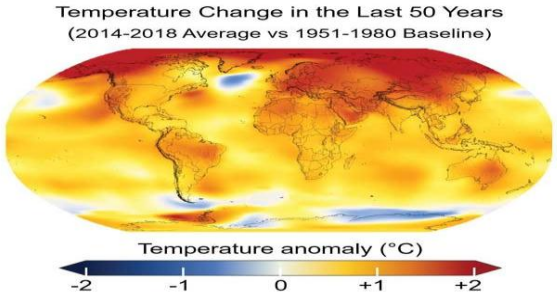


**Fig-2 Change of Temperature**

### 3. HISTORY OF BUILDING MATERIALS BEFORE CEMENT:

Constructional works like buildings, bridges and roads are originated before 400 B.C., on the other hand, the usage of cement started from1824 A.D. then what binding materials were used at that time? Not only that some relics are still present today i.e. lasting more than 2000 years. It is observed that in Egypt, calcined gypsum were used as a cement or binding materials. Greeks and Romans used lime made by heating limestone adding sand to make mortar, with coarser stones to make mortar, with coarser stones for concrete. Also they used volcano ash, lime and sea-water for chemical reaction. British engineers used limes, brick dust, molasses and catchy for constructional works. So the constructional materials for civil works originated from chemical composition.

#### 3.1. Modern Construction:

**A. Iron & Steel:**

Invention of iron-making process advanced the human civilization too far. Today constructional works are unthinkable without it. Beams, columns, roof-structure requires the use of steel and iron to erect the primary structure. Iron ores is a mixture of iron, oxygen and other elements .Iron ores are at first roasted in calcimine climes, then put to blast furnace to remove impurities. All these are done through chemical process. A civil engineer cannot move an inch without iron and steel which is a product of chemical process.

**B. Bitumen:**–It is an another vital material for road and highways construction. It is used for hard durable road construction. It is a heavy black viscous oil comprised of a mixture of sulphur, nickel, trace materials, lead, chromium, mercury, arsenic selenium and other toxic elements. It acts as a sealant and water-proofing agent for several years.

Petroleum bitumen, normally called bitumen or asphalt is produced by refining crude oil which is composed of heavy carbon. Bituminous Mixture is the term used for to denote all materials in which an aggregate is bound with hydro-carbon binder. It is extensively used as surfacing materials for road construction. In modern road construction work when bitumen is direct burning in hot mixing plant then $CO_2$ emission increasing.

**Fig-3 Burning Bitumen**

### 4. ENVIRONMENTAL CHEMISTRY:

It is a branch of science which deals with the chemical factors or ingredients of environment—its sources, chemical reactions and substances effecting the environments either in good or bad ways .Some terms are used in environmental chemistry— such as pollutants, contaminants, sources, sink, receptor, or target pathways of pollutants etc. There are some gaseous pollutants which affect the existing buildings, monuments, marbles, bridges made out of iron and steel. Main gaseous pollutants are $SO_2$, $CO_2$, $NO_2$, $H_2S$, and $CH_4$ etc.

i) $SO_2$—Among the air pollutants gases the presence of $SO_2$ more than 30%. By this Sulphuric acid highly affected the buildings made out of lime stones or marbles, monuments etc.

ii) $SO_3$—Mixing with $SO_2$ and $NO_2$, $SO_3$ originated. It reacts in when comes in contact with watery vapors in the air and produces aerosol and come down as an acid rain. It has harmful effect on land, water, plants and animals, in short in the environment. Acid rains accelerates the decay of buildings, statues, sculptures, paints, monuments those our parts of national heritage (Taj Mahal, Victoria Memorial Halls etc.) Marbles stones ($CaCO_3$) mixing with the acid ,creates a salt layer .Researchers have proved that yellow spots on the Taj Mahal are due to $SO_2$ and Acid rains from Mathura Oil refinery. It is called stone leprosy or stone cancer.

iii) $SO_x$ -As a sink of $SO_x$ affects the buildings limestone, monuments, paints, varnishes etc. It has an erosive influence.

iv)Green house gases—Carbon-di-oxide, Methane .CFC, water vapour etc. are the generator of GHG .It is one of reasons of global warming.

v) Rusting (—Iron & steel.) ---Rusting is one of the enemy of iron and steel, it weakens the strength of iron and steel, steel plates, beams etc. Rust comes in the contact of oxygen and water. It causes to corrode and deteriorate the strength and durability. It is due to oxidation and chemical reaction.

## 4. EXPERIMENTAL RESULTS:

Here are some experimental results on the zeolites block and how it is absorbing $CO_2$ from the atmosphere.

| Wt. of block | B1 (30% Substitution) | B2 (20% Substitution) | B3(30% Substitution) | B4(Normal Concrete Block) |
|---|---|---|---|---|
| On 10th day(gm) | 859 | 942 | 885 | 896 |
| On 14th day(gm) | 863 | 947 | 890 | 889 |
| On 21st day(gm) | 876 | 958 | 907 | 874 |
| On 25th day(gm) | 884 | 963 | 913 | 858 |
| On 28th day(gm) | 888 | 967 | 916 | 851 |

**Table-2**

- **Calculation:**

  Calculation of $CO_2$ absorbed by block= Final weigh-Initial weigh/molecular wt. of $CO_2$

  $CO_2$ absorbed by

$B_1$-888-859/44=0.65 mole,

$B_2$=0.56 mole,

$B_3$=0.70mole

Average amount of $CO_2$ absorbed =0.63

## 5. DISCUSSION:

From the above results:

1. It can be utilized any type of building construction.

2. Using Zeolite concrete block, it is absorbing $CO_2$ 0.63 mole average.

3. Reducing pollution and make slow corrosion of reinforcing steel in concrete.

## 6. CONCLUSION:

In fine, it can be concluded that cement manufacturing process , direct bitumen burning, acid rain, global warming etc. which are directly or indirectly inter-related among the three disciplines with each other. To get an idea of civil engineering perfectly, it is imperative to study through inter-disciplinary orientation. In order to create green and sustainable environment civil engineering, chemistry , chemical engineering and environmental engineering must work together to reduce environmental pollution. They can undertake the research work for utilizing alternative fuel, recycling energy, agents, zeolites, benzenes etc. to reduce the degree or the level of pollution and global warming. For example, wet scrubber process can remove 90%-95% $SO_2$, Heptanes, as a non-polar solvent can be used in paints, coatings and solvent of rubber cement. Calcium nitrate can reduce corrosion or slow corrosion in iron and steel. Solar energy can minimize the $CO_2$ emits from fuel consumptions by vehicles. All these facts are gained through inter-disciplinary exchange of knowledge which benefited the aforesaid three disciplines as well. So, such inter disciplinary approach is highly useful for creating pollution- free green globe for future generation.

- **FUTURE SCOPE:**

With the advancement of knowledge and scientific investigation, new things, ideas, new techniques are achieved by the researchers. This paper confined its discussion of inter-disciplinary approach among civil engineering, chemical engineering and Environmental engineering but it is not complete, it can be extended or enhanced which are not discussed here .For example, the relationship with physics, mathematics or geometry etc. can be undertaken by the new coming researchers. So its future scope is broad and extensive. It needs only time, energy and capabilities to explore by the new researchers.

## REFERENCES

[1] Khanna & Justo – HIGHWAY ENGINEERING.

[2] Garg, S.K –Environmental Engineering.

[3] Khatib, J.M Sustainability of Construction Materials; Woodhead Publishing Limited : Cambridge, UK.2009

[4] Dilip Kumar Mondal, Chandan Surabhi Das –Population and Environmental Education- Rita Publication Kolkata 2012.

## BIOGRAPHIES

Soumita Mondal
M.Tech Scholar in Civil Engineering Department of Kalinga University, Naya Raipur (C.G), India.