# ANALYSIS ON EFFECT OF CARBAMIDE ON ENGINEERING PROPERTIES OF CLAY SOIL

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***ABSTRACT:***

*Fertilizer contamination of soil is occurred due to application of fertilizer to soil for plant growth. It percolates steadily into subsurface environments and contaminates the soil and water system. One of the major contaminant sources is agricultural field. The extensive use of fertilizers contaminates the soil and the contamination has not just affected the quality of the soil but will also alter the geotechnical properties of soil and quality of ground water. The large amounts of carbamide (urea) fertilizers which are used in agricultural activities in India leads to the contamination of large quantities of soil surrounding the agricultural fields. An extensive laboratory testing program is carried out to determine the compaction characteristics, hydraulic conductivity, and shear strength parameters of uncontaminated and contaminated soils for comparison. Two types of soils are used including fine to medium sand and clay. Contaminated specimens are prepared by mixing the dried soil samples with different carbamide concentrations of 2,4,6 and 8%. Based on the laboratory tests it is found that a considerable effect occurred on the hydraulic, compaction and shear strength characteristics of soil due to the application of carbamide in it. These soils might be used for geotechnical purposes and the results obtained will benefit to engineers or decision makers in recycling or re-using of contaminated soils.*

*KEY WORDS: Carbamide, Fertilizer contamination, compaction characteristics, recycling or re-using*

## I. INTRODUCTION

India is on the path of rapid industrialization & urbanization. Better work opportunities & the dream of better lifestyle has spread rural migration. The infrastructure development of the boomed structure has not able to keep waste influx within the cities & the municipalities are straining their limits providing basic service. Solid waste has been major environmental issue in India. MSW in cities is collected by respective municipalities & transport to the outskirts of the city. The limited reviews and high amount make them ill equipped to provide high cost involved in collection, storage, transportation, processing etc as a result a substantial part of MSW generates remains unattended and grows in heaps at collection centre. There is a lack of awareness among the peoples about the proper segregation at the source. As India population has been increasing continuously, along this education system also grows continuously.

## II. LITERATURE REVIEW:

[1]Tthe geotechnical properties of fertilizer-contaminated soils as well as uncontaminated soils for comparison. Testing programs performed on the studied soils included basic properties, Atterberg limit, compaction, unconsolidated untrained triaxial test, unconfined compressive strength test, and CBR test. Soil samples were artificially contaminated with 2.5 and 5% urea of the dry weight of silty soils. The results showed that the addition of fertilizer is less affect the Specific gravity and plasticity Index while more affect the Plastic limit and CBR value of silty soil and rest of properties are moderately affected.[2] An extensive laboratory testing programes carried out to determine the Atterberg limits, compaction characteristics, hydraulic conductivity, and shear strength parameters of clean and contaminated soils. Contaminated specimens are prepared by mixing the dried soil samples with different di-ammonium phosphate concentrations of 5, 10, and 20 %. The results indicate a significant reduction in Atterberg's limits and increase in hydraulic conductivity for silty clay soil with the increase of phosphate concentration. For sand soil, $\gamma_{dmax}$ is significantly increased. However, the general trend of hydraulic conductivity is towards reduction. In addition, the friction angle of two sand samples decreases about 10 % due to the increase of DAP concentration up to 20 %. For silty clay, the reduction in cohesion is about 20 % and the increase of friction angle is about 10 % with the increase of DAP up to 20 %. [3]To improve the natural sub grade soil's strength using polymer resins. The improvement may be through increasing compressive strength, flexural strength and California bearing ratio. The urea-formaldehyde resin was used in this study, as a soil stabilizing agent, to improve the characteristics of desert and beach sands. Comparison was done of properties of soil with no modified urea-formaldehyde resin and with modified urea-formaldehyde resin. The results are encouraging since the addition of the urea formaldehyde resin increase the compressive strength which enables the sands to carry the heavy traffic. In addition, California bearing ratio, dry density, abrasion resistance and water absorption have

been improved to use in the construction of highways. [4] The application amount, period and times of N fertilizer were important to maize yield. In the present study, nine treatments of N fertilizer application were carried out to evaluate the variances of soil physical and chemical, the contents of N, P and K in plant and maize grain yield. Results indicated that the soil bulk densities were increased, whereas the soil porosity, field capacity and pH values were decreased with more N application. Reasonable N fertilizer amount (241.5 kg/ha) and application at two stages (30% at sowing and 70% at jointing stage) could significant increase N utilization efficiency and improve maize yield.[5] Properties of a cohesion less soil were stabilized by using Astragalus. In order to find out which rate of the additive caused maximum strength parameters of the soil samples which prepared by using four different replacement amounts of 0%, 3%, 5% and 10% by weight of soil. Maximum dry densities and optimum moisture contents were determined for each mixture. Strength parameters of each mixture were also determined. According to experimental study, adding 1% of Astragalus content is convenient for sandy soil when considered strength parameters and economical respect of additive material.

## III. MATERIAL USED:

Urea(CARBAMIDE) is also known as carbamide, is an organic compound with the chemical formula CO(NH2)2. This amide has two -NH2 groups joined by a carbonyl (C=O) functional group serves an important role in metabolism of nitrogen containing compounds by animals. It is a colorless, odorless solid, highly soluble in water and practically non- toxic.

Table1. Properties of Carbomide.

| **Chemical formula** | **$CH_4N_2O$** |
|---|---|
| Molar mass | 60.06 g/mol |
| Melting point | 133 to 135°C |
| Density | 1.32 g/cm³ |
| Solubility in Water | 1079 g/L(20°C)<br>1670 g/L(40°C)<br>2510 g/L(60°C)<br>4000 g/L(80°C) |
| Appearance | White solid |
| Flash point | Non-flammable |

**Fig 1: Carbamide.**

## III. INDEX PROPERTIES OF SOIL SAMPLE.

Initially the Index properties such as Specific Gravity, Grain size distribution, liquid limit, plastic limit, plasticity index and specific moisture content, Optimum moisture content, maximum dry density of the soil sample are found in the laboratory with un contaminated soil sample.

| **Property** | **Value** |
|---|---|
| Specific gravity of clayey soil | 2.5 |

| | |
|---|---|
| Liquid limit | 47% |
| Plastic limit | 26.7% |
| Plasticity index | 20.3 |
| Optimum moisture content | 14% |
| Maximum dry density | 0.136 $g/cm^3$ |
| Coefficient of permeability | $1.58x10^{-6}$ cm/s |
| Compressive strength | 63 $kN/m^2$ |

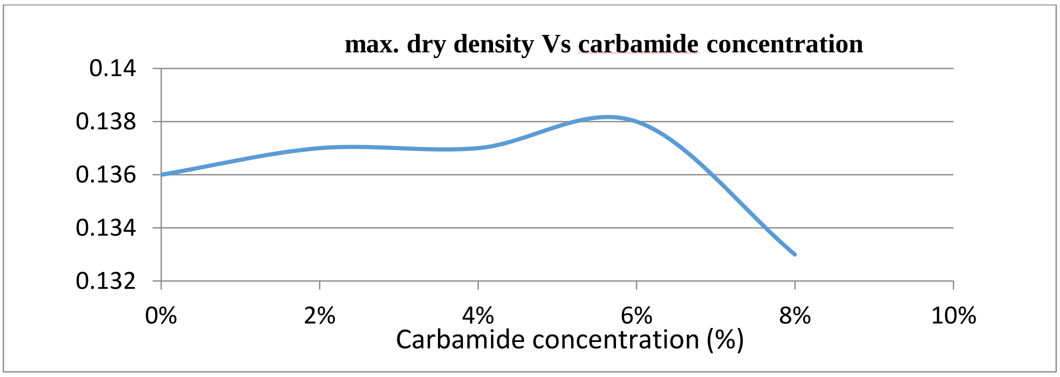
Table 2. Index properties of Un contaminated clay sample

## IV.ENGINEERING PROPERTIES OF SOIL SAMPLE.

**PROCTOR COMPACTION TEST.** The soil sample is subjected to concentration in different percentile to find the effective concentration .the clay soil is concentrated with carbomide in 2%, 4%, 6%, 8%.

| Carbamide concentrations | Max. dry density | Optimum moisture content |
|---|---|---|
| 0% | 0.136 $g/cm^3$ | 14% |
| 2% | 0.137 $g/cm^3$ | |
| 4% | 0.137 $g/cm^3$ | |
| 6% | 0.138 $g/cm^3$ | |
| 8% | 0.133 $g/cm^3$ | |

Table 3. Optimum moisture content for contaminated soil.




**Graph 1.** Optimum moisture content of the contaminated clay

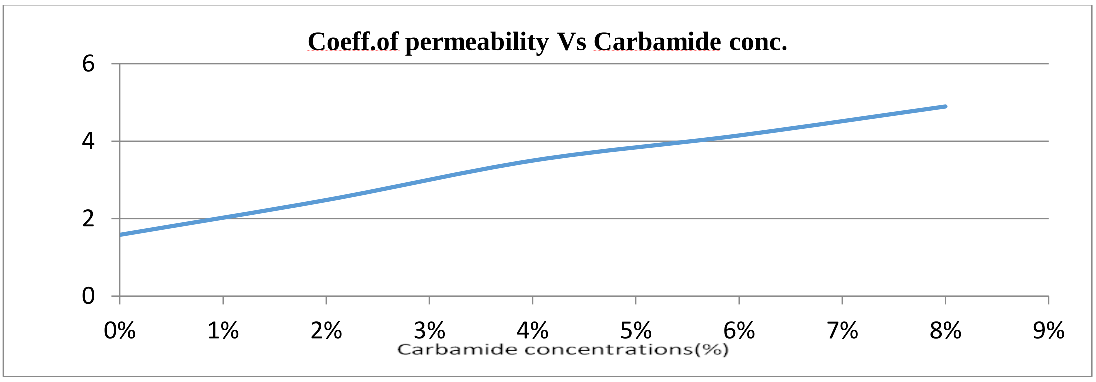
From the analysis of data obtained from standard proctor compaction tests, the optimum moisture content is same for every Carbamide concentrations. That is 14%. But maximum dry density is increased by increasing percentage of Carbamide and which is maximum at Carbamide concentration of 6% and then decreased to a lower value.

**PERMEABILITY TEST**: The purpose of this test is to determine the permeability (hydraulic conductivity) of a sandy soil by the constant head test method. There are two general types of permeability test methods that are routinely performed in the laboratory:The constant head test method, and (2) the falling head test method. The constant head test method is used for permeable soils (k>10-4 cm/s) .

| Variable head Permeameter | |
|---|---|
| **Carbamide concentrations** | **Coefficient of permeability** |
| 0% | $1.58x 10^{-6}$ cm/s |

| | |
|---|---|
| 2% | $2.48x\ 10^{-6}$ cm/s |
| 4% | $3.50x\ 10^{-6}$ cm/s |
| 6% | $4.15x\ 10^{-6}$ cm/s |
| 8% | $4.90x\ 10^{-6}$ cm/s |

Table 4. Constant head and variable head Permeability.



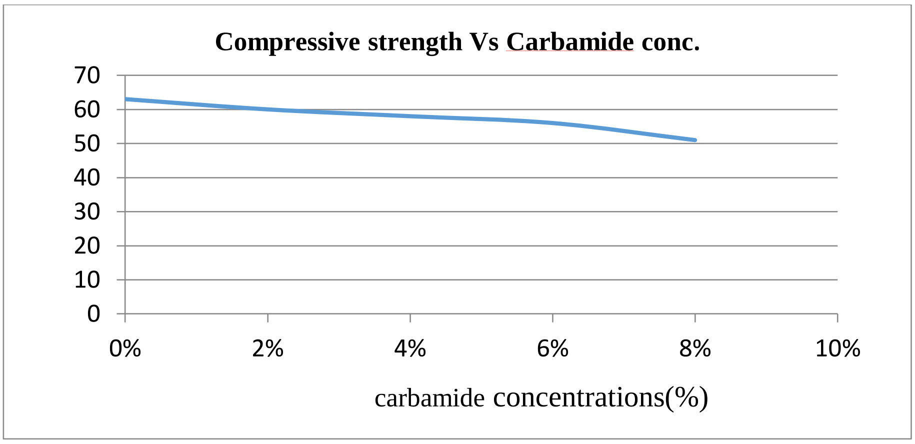

Graph 2. Falling head permeability

From the analysis of data obtained from falling head permeability tests, the coefficient of permeability is increases with increase in Carbamide concentration.

**TRIAXIAL COMPRESSION TEST.** Specimens from drill cores are prepared by cutting them to the specified length and are thereafter grinded and measured. There are high requirements on the flatness of the endsurfaces in order to obtain an even load distribution. Recommended ratio of height/diameter of the specimens is between 2 and 3.

| **Carbamide concentrations** | **Compressive strength ($kN/m^2$)** |
|---|---|
| 0% | 63 |
| 2% | 60 |
| 4% | 58 |
| 6% | 56 |
| 8% | 51 |

Table 5. Triaxial test results.




Graph 3. Triaxial testing results for contaminated soil sample.

From the analysis of data obtained from triaxial compression tests , for clayey soil the compressive strength slightly decreases with increase in carbamide concentration.

## V. CONCLUSION.

.For clayey soil, the hydraulic, compaction and shear strength characteristics are altered slightly due to the effect of carbamide. From the analysis of data obtained from standard proctor compaction tests, the optimum moisture content is same for every carbamide concentrations. That is 14%. But maximum dry density is increased by increasing percentage of carbamide and which is maximum at 6% of carbamide concentration and then decreased to a lower value. From the analysis of data obtained from falling head permeability tests, the coefficient of permeability is increased with increasing carbamide concentration. From the analysis of data obtained from triaxial compression tests, for clayey soil the compressive strength slightly decreased with increasing carbamide concentration. The results showed that sand with 6% carbamide contamination might be used for geotechnical purposes. In clayey soils 6% carbamide contamination will give a higher maximum dry density value. Due to the decreasing characteristics of compressive strength, carbamide contaminated clayey soils not suitable for geotechnical purposes.

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