# Study on the Shape and Texture of different types of Fine Aggregates used in Concrete using Foldscope

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*Abstract:* Size and morphological characteristic of fine aggregate play an important role to study the workability parameters of concrete and mortar. In this study, the morphological characteristics like angularity, roundness, sphericity and roughness were selected. The soil grains of different size of fine aggregate are examined using foldscope microscope. The parameters varied in the paper are the type of the soil, source of the soil and depth from which soil sample is taken. The soil samples are collected from the natural resources - River- sand, fertile soil, red soil clay, sea sand and artificial sources - M-Sand and P-Sand . From the image it is able to know the shape and texture of the sample and corresponding correction in the concrete mix design can be done to improve the fresh concrete properties.

***IndexTerms*** **- Particle size- Morphology, Soil grains, shape, Foldscope.**

## I. INTRODUCTION

Foldscope is an optical microscope formed by assembling the sheet of paper and a lens. It is the cheapest and easy tool to observe the biological and non – biological samples with the resolution of 2 microns and 140X magnification. Manu Prakash[1] at Stanford University invented the foldscope, for use in remote to identify disease organisms.Figure 1 shows the image of the Foldscope. Heemun Jang and Thomas H.Etsell [2] have studied the morphological and Mineralogical characteristics of oil sands fly ash at various temperature. The ashes were subjected to low to high temperature and its behaviour was examined using scanning electron microscope (SEM) and X-ray diffraction analysis (XRD). Judith A. Bazler, Meta VanSickle and Carleigh Engstrom [3] have studied the foldscope and its application. A pre-service science teacher used the foldscope for fieldwork at Sandy Hook New Jersey on both the bay and ocean side of the national park. A sampling of both sides of Sandy Hook New Jersey, bay side and ocean side, was done to determine the usability of the foldscope in the field component of coursework and for use in a science classroom.The foldscope study on the different grades of maize starch powder was carried out by Joshi et.al [4] and concluded that different types of crystals were present in the samples. James et.al [5] has described the large scale manufacturing cost of the origami based paper microscope and its instrumentations. Ephraim et.al [6] have diagnosis's the kind of infection using mobile phone microscope and it can used as global tool for health applications. Many researchers [7-8] studied foldscope and its application in the various fields of sciences.

In this paper the morphological study was carried out for the different soil samples collected from the different sources. The fine aggregate samples that are collected for study are river sand, fertile soil, red soil, clay, sea sand, M sand and P sand. Figure 2 shows the preparation of various soil samples in a glass plate for view through foldscope.


**Figure 1 Image of the Foldscope**

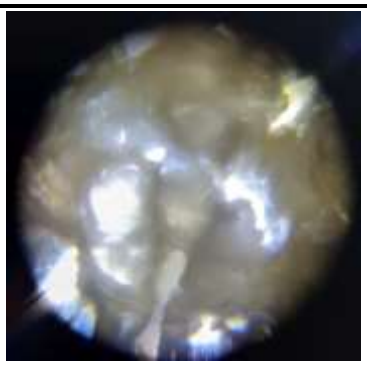

**Figure 2 Soil sample in the glass strip for observation**

## II. RESULT AND DISCUSSION

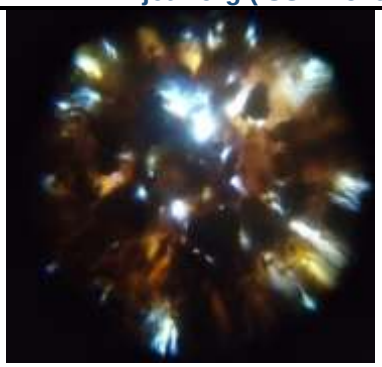
The foldscope can be easily handle, and it is used for interpretation of physical properties like crystallanity of the soil and its structure, the image quality seems to be superior when foldscope can be connected to a smartphone with the help of magnetic coupler for the user to take pictures of the different magnifications.

The soil has a lot of shards of inorganic and organic material in it. The presences of the fungal growth are also able to observe from the soil sample which is taken from the depth of 20cm. Figure 3 shows the foldscope images of the different soil sample. Table 1 gives inferences made in the foldscope images of the soil sample. From the table it is observed that the different soil sample has different shapes. The shape and surface texture generally affects the fresh concrete properties rather than hardened properties of concrete. The angular and elongated particles require more water to make workable concrete than the round and granular aggregate. The M sand are mostly elongated in shape, it requires more water-cement ratio to get good workability. The river sand cannot be used for making concrete because of the presence of the sulphate and chloride content in it. This reacts with the chemical present in the cement and affects the strength of concrete. Figure 3 shows the image of river sand in wet and dry stage. The image of the red soil is different, because of the presence of red oxide in the soil. Thus shape and texture of the fine aggregate which affects the fresh concrete properties can be examined. The images using foldscope helps to study the soil sample before doing mix design for concrete and mortar.

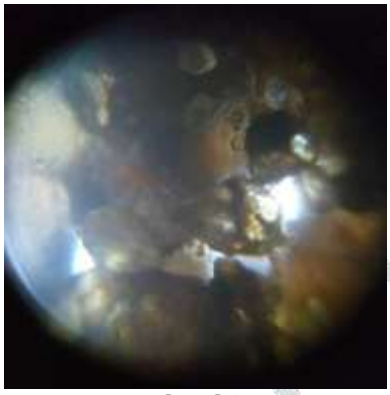
M-Sand



P-Sand



Red Soil (Top)

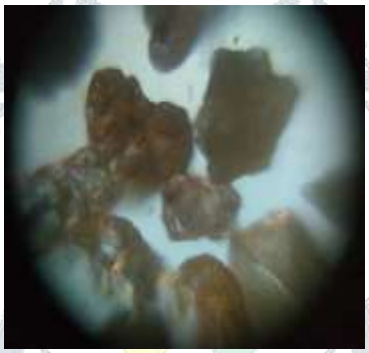


Red Soil (Deep)

Fertile Soil (Top)

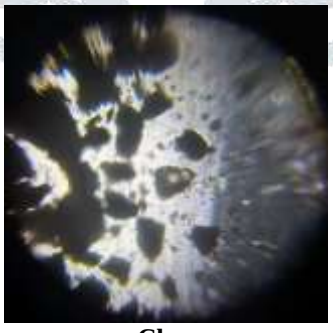
Fertile Soil (Deep)

River Sand



Sea Sand (Dry)

Sea Sand (Wet)



Clay

**Figure 3 Foldscope images of the different soil sample**

**Table 1: Inferences from the fold scope image of the soil sample**

| Sl.No | Type of soil | Source | Inference |
|---|---|---|---|
| 1 | River Sand | Natural Top layer | It is crystalline in nature<br>All the grains are irregular in shape |
| 2 | Fertile soil | Natural Top layer | It is not transparent |
| | | Natural Deep – 20cm | Able to observe the different sizes of the grains with different morphology. |
| 3 | Red soil | Natural Top layer | It is transparent<br>All the grains are granular in shape |
| | | Natural Deep – 20cm | It is transparent<br>All are grains are flaky and granular in shape |
| 4 | Clay | Natural Top layer | It is not a transparent soil<br>All the grains are irregular shape |
| 5 | Sea Sand | Natural - Dry | It is transparent<br>All the grains are granular in shape |
| | | Natural - Wet | It is transparent<br>Occurrence of sulphate content |
| 6 | M-Sand | Manufactured sand | It is not transparent<br>All the grains are elongated in shape |
| 7 | P-Sand | Manufactured sand | It is Transparent<br>All the grains are angular in shape |

## III. CONCLUSION

From the study, it is concluded that using the folscope in the field for analysis of both natural and artificial fine aggregate was valuable in order to know the morphological characteristics. The images using smart phones of the samples are clear and easily able to examine the shape, texture and the presence of the microorganism in the soil sample. Accordingly the concrete mix design will be carried out to achieve the required workability and strength of the concrete and mortar.

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