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Synthesis and Characterization of Silica from Zea Mays

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***Abstract*:- Preparation and characterization of silica powder from zea mays plant were carried out in this work. Zea mays plants were collected from the nearby agricultural land. Parts of the Zea mays plant were separated like cob, husk, leaf and stalk then they were dried at open air. Then they were treated with HCl to remove some impurities. Both treated and untreated Zea mays parts were burnt in the muffle furnace at various temperature like 600ºC, 625ºC, 650ºC, 675ºC. Ash were stirred in NaOH to form sodium silicates solution, Heated in 250 ml Erlenmeyer flask, Then the filtrate were allowed to cool under room temperature, H_2SO_4 is added to the sample until the sample reaches pH 2, After that NH_4OH is added to the sample until the sample reaches pH 8.5 then leave it for 3.5 Hours, filtrate were dried at 240ºC for 1.5 Hours to obtain pure silica. Prepared silica powder was characterized using EDAX technique. Silica powder with 93.87% silica content was obtained from leaf after burning at 625ºC.**

Keywords: Zea mays, Silica powder, Ferrocement specimen, Mechanical properties.

1.INTRODUCTION:

Silicon accumulation has been found to a greater extent in the families Poaceae, Equisetaceae and Cyperaceae show high Si accumulation (.4 % Si), (Hodson et al., 2005)[1].Zea mays commonly known as maize it belong to the Poaceae family under the kingdom Plantae. Maize is cultivated widely throughout the world and has the highest production among all the cereals and contributes to food security in most of the developing countries like India. Its importance lies in the fact that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry, corn oil production, baby corns etc. Corn production has nearly doubled from around 12.0 million tons in the early 2000s to around 22 million tons today.According to FICC 5th India Maize Summit 2018 USA is the largest producer of maize in the world, followed by China and Brazil; Production of maize in India has increased at 5.5 per cent from 14 MnMT in 2004-05, 23 MnMT in 2013-14 to 24 Mn MT in 2016-17.

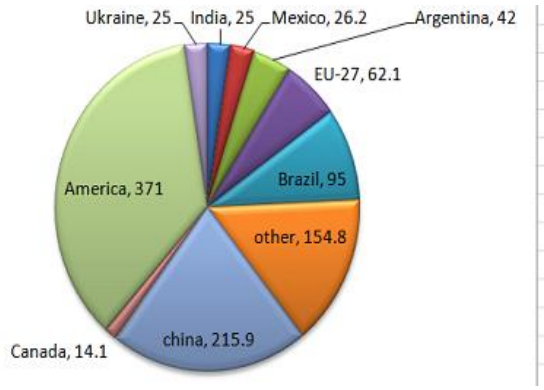

Fig1: Production of maize the world 2017-2018

silica powder with 90.6% silica content was obtained from CCA after burning at 600 ºC, (T. Chanadee et al., 2016) [2]. Relatively high content of silicon was found in corn cobs which could be converted into silica (SiO2) in form CCA. Purified CCA silica can be obtained from burning corn cobs in air followed by extraction with alkaline or acid solutions(Shim J.,et al., 2015) [3]. D.A.Adensanya et al., and A.A. Raheem et al., [5-6] were studied the influence of corn cob ash in blended cement concrete and the study found that corn cob ash is a suitable pozzolanic material for cement replacement The objective of this research work is to obtain silica from the Zea mays plant. From this method, silica powder can be produced at low cost and agricultural wastes can be reduced to prevent pollution. As-prepared silica powder was characterized by using E-DAX and SEM (Scanning electron microscopy) techniques.

2. MATERIALS:

Zea mays were collected from the nearby agricultural land, they were dried at open atmosphere. Parts of the Zea mays were separated in order to find the silica content find in its various parts like stalk, Husk, Leaf and Cob,the parts of the Zea mays plants were washed with normal tap water until the water turns into clear,then they were washed with distilled water atleast thrice to remove organic impurities.

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The Zea mays were pretreated with HCl to remove soluble metallic impurities. Both treated and untreated parts of Zea mays were calcined at temperature 600ºC, to obtain their respective ashes. These samples were Characterised using E-DAX so as to find the various chemical compositions in the ashes, From the test results of E-DAX given in fig( ) leaves and husk shows the high amount of silica content present in the given sample.

3. EXPERIMENTAL:

3.1 Synthesis of silica powder:

Then the treated leaves and husk are clacined at various 600ºC, 625ºC, 650ºC, 675ºC.the ashes were produced,the ahes were grinded using mortar and pestle, From that 10 g of sample is stirred in 80ml of 3N NAOH. The sample were heated in 250ml Erlenmeyer flask for 80 ºC for about 3 Hrs.The solution were filtered and the residue were washed with 20 ml boiled distilled water, Then the Filtrate was allowed to cool down at to room temperature, the filtrate were added with 5N H_2SO_4 until the sample reaches pH 2, After that NH_4OH is added to the sample until the sample reaches pH 8.5 then leave it for 3.5 Hrs, filtrate were dried at 240ºC for 1.5 Hours to obtain pure silica. The obtained silica powder is characterized by using E-DAX(Energy Dispersive X-Ray Analysis- Oxford instruments, UK) and SEM(Scanning electron microscope-Joel Japan).

3.2 Characterization of silica powder :

The silica content in zea mays were investigated by using Energy Dispersive X-Ray Analysis to determine its chemical compositions and also by using Scanning Electron microscope inorder to find out the average size of the particles.under 20kV.

4. RESULTS AND DISCUSSIONS:

4.1 Energy Dispersive Spectroscopy:

Figure(2a-d)shows the elemental composition of Zea mays before acid treatment after the calcinations at 600ºC produced residues composed mainly of elements Na, Mg, S, Si, K,P, Ca and Cl.

The high oxygen proportions indicate presence of oxides of the elements.

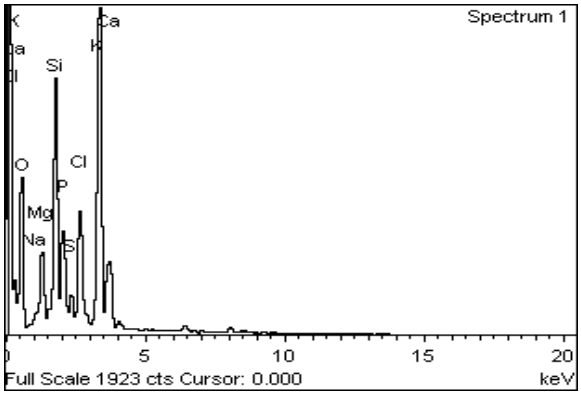

Fig 2 a:EDAX result analysis of Cob before acid treatment.

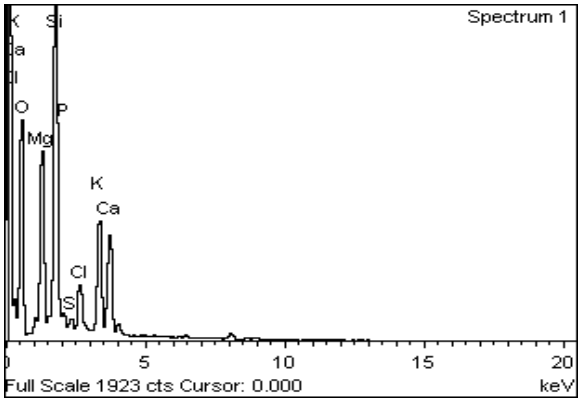

Fig 2b:EDAX result analysis of Husk before acid treatment

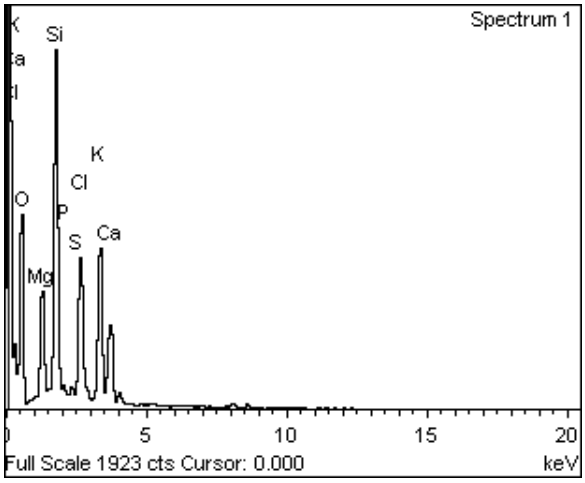

Fig 2c:EDAX result analysis of Leaf before acid treatment

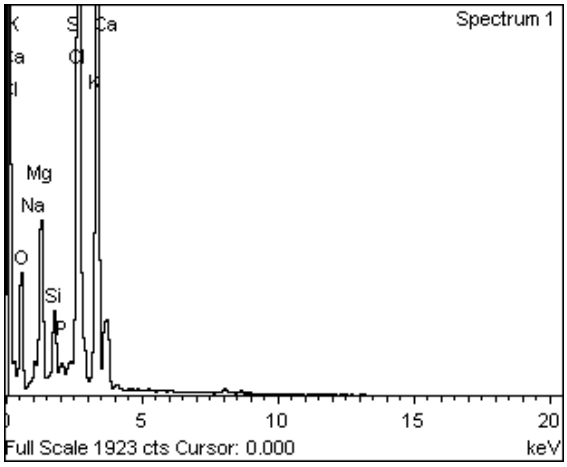

Fig 2d:EDAX result analysis of stalk before acid treatment.

Table1:Composition of silica present after calcinations @600 ºC for about 3 Hrs before acid treatment

Sample	stem	leaves	husk	cob
% silica	59.6	80.6	81.7	73.93

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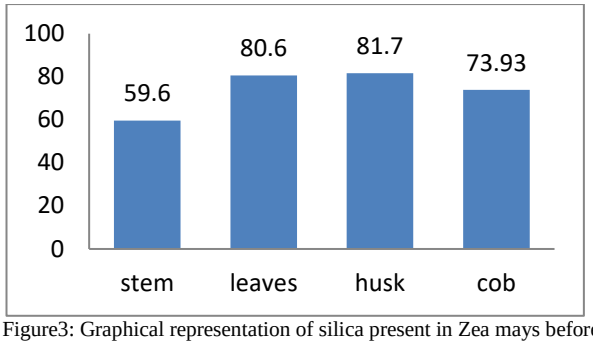

Figure3: Graphical representation of silica present in Zea mays before acid treatment.

From the results of EDAX (Table 1) leaves and husk shows the major composition of silica,So the husk and leaves of the zea mays plant were picked for the further process.

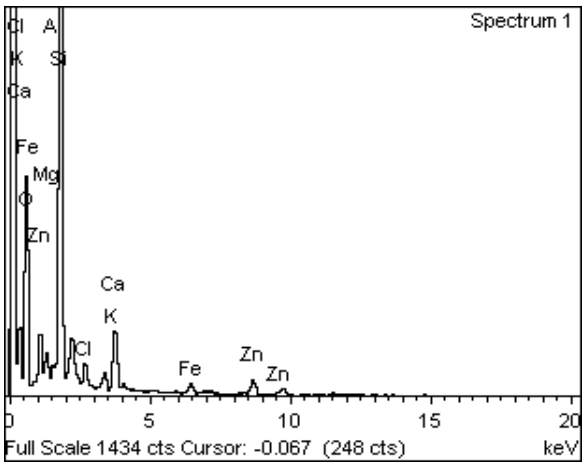

Fig 4a:EDAX result analysis of Husk after acid treatment@ 600 ºC

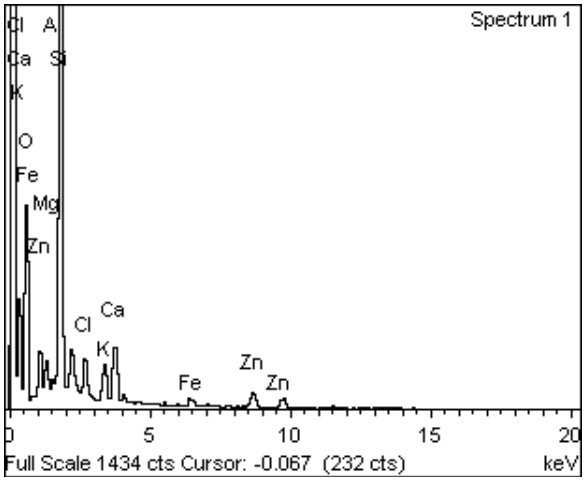

Fig 4b:EDAX result analysis of Husk after acid treatment@ 625 ºC

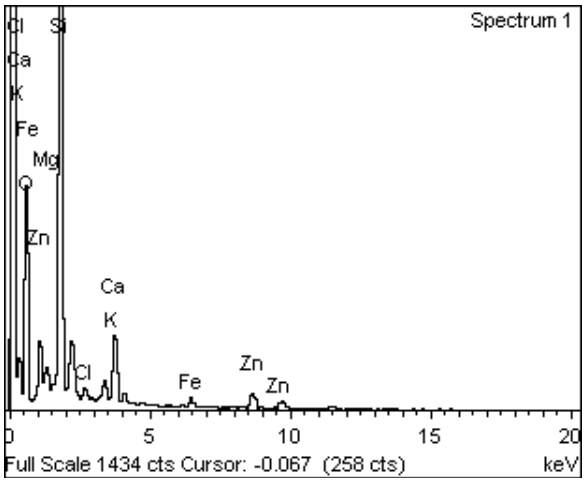

Fig 4c:EDAX result analysis of Husk after acid treatment@ 650 ºC.

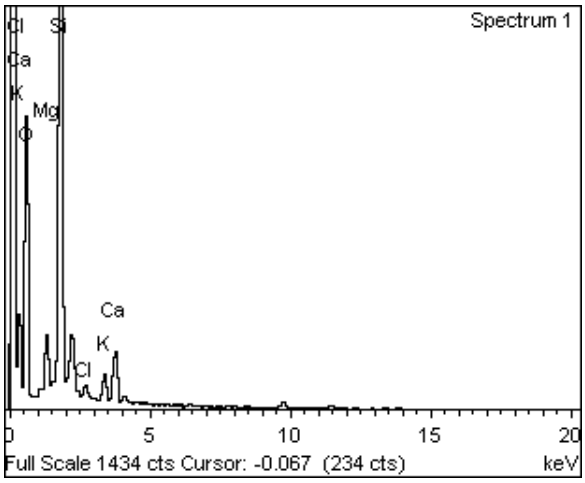

Fig 4d:EDAX result analysis of Husk after acid treatment@ 675ºC.

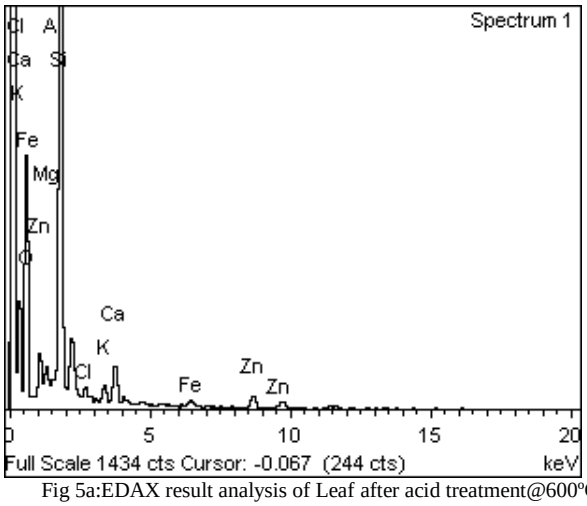

Fig 5a:EDAX result analysis of Leaf after acid treatment@600ºC

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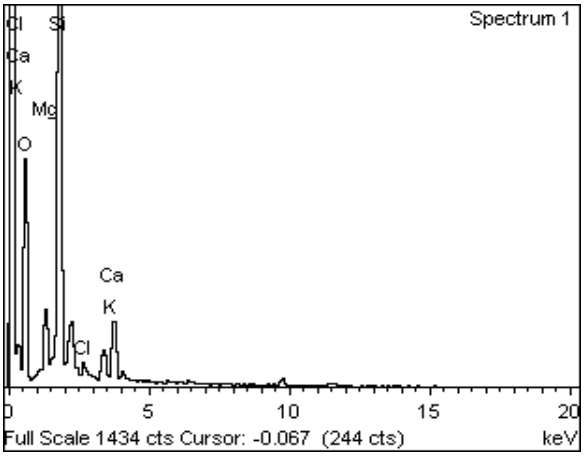

Fig 5b:EDAX result analysis of Leaf after acid treatment@625ºC

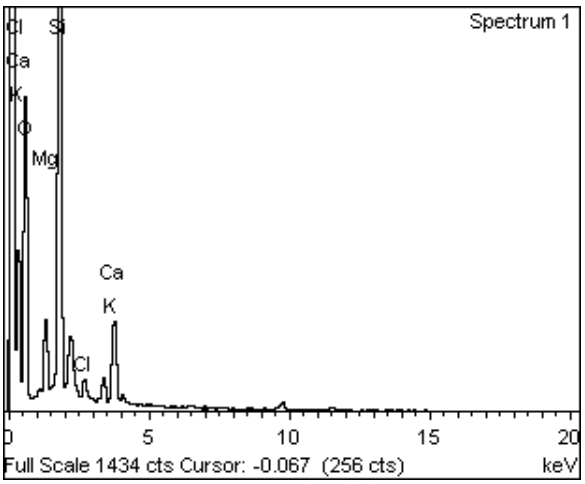

Fig 5c:EDAX result analysis of Leaf after acid treatment@650ºC

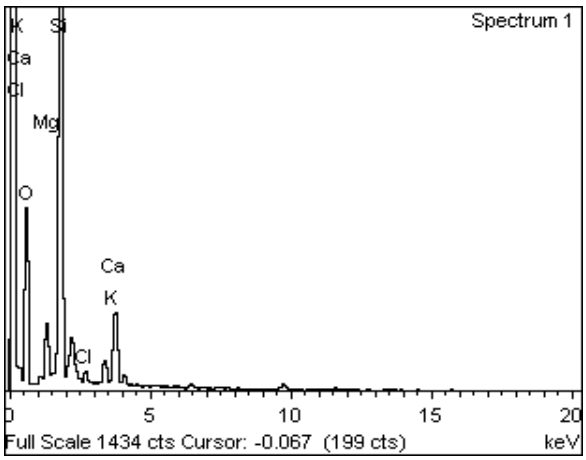

Fig 5d:EDAX result analysis of Leaf after acid treatment@675ºC.

Table2: Silica Composition in husk at various temperature.

Tempatature	600 ºC	625 ºC	650 ºC	675 ºC
%Silica	89.85	88.18	90.88	92.92

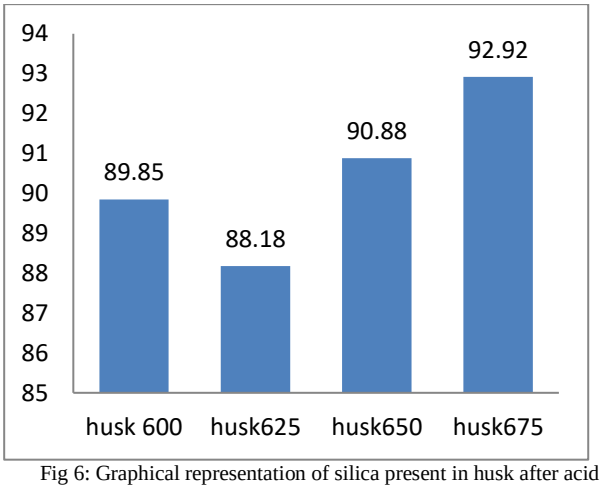

Fig 6: Graphical representation of silica present in husk after acid treatment.

Table3: Silica Composition in Leaf at various temperature.

Tempatature	600 ºC	625 ºC	650 ºC	675 ºC
%Silica	92.68	93.87	91.83	91.48

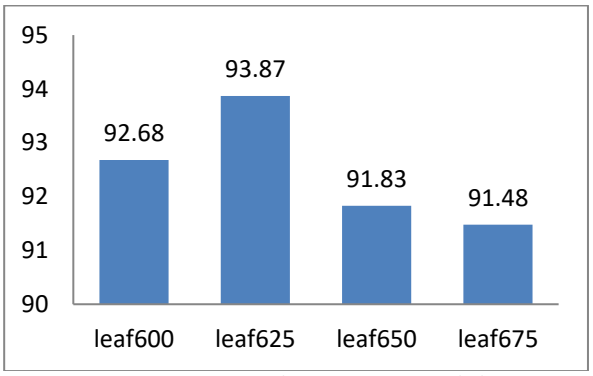

Fig 7:Graphical representation of silica present in leaf after acid treatment.

4.2 SEM (Scanning electron microscope).

Scanning electron microscopic analysis were carried out to determine the particle size and surface morphology of the particles. Fig(8.a-8.d) shows the SEM images of Synthesized silica from leaves with different magnification (x1000, x2000, x5000, x10000).While Fig (9.a-9.d) shows the SEM images of Synthesized silica from Husk with same magnification. The images clearly shows the average size of the particles for both husk and leaves were in the range of 1µm to 10 µm .

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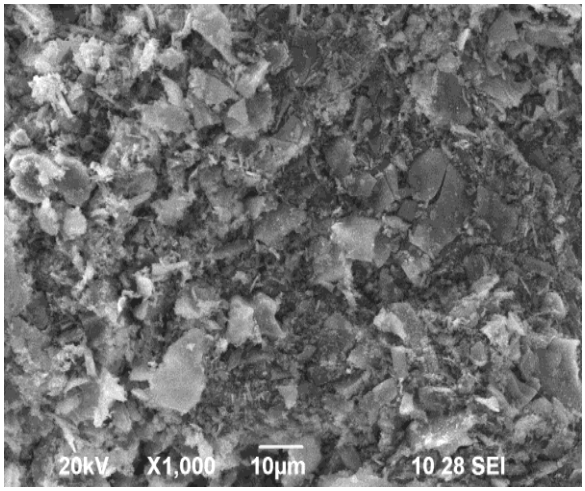

Fig8a: SEM result analysis of Leaf at X1000 magnification.

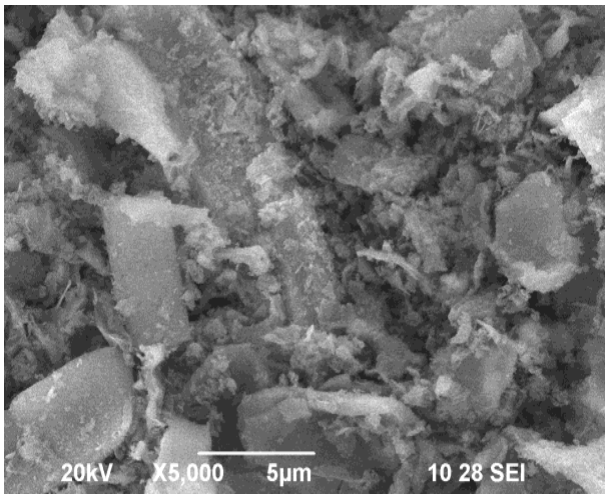

Fig8b: SEM result analysis of Leaf at X5000 magnification.

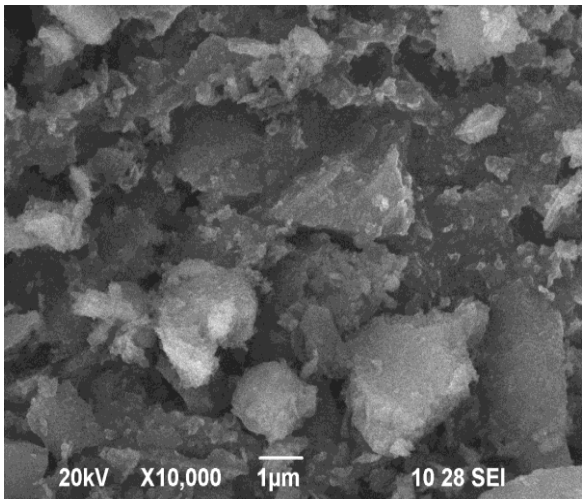

Fig8c: SEM result analysis of Leaf at X10000 magnification

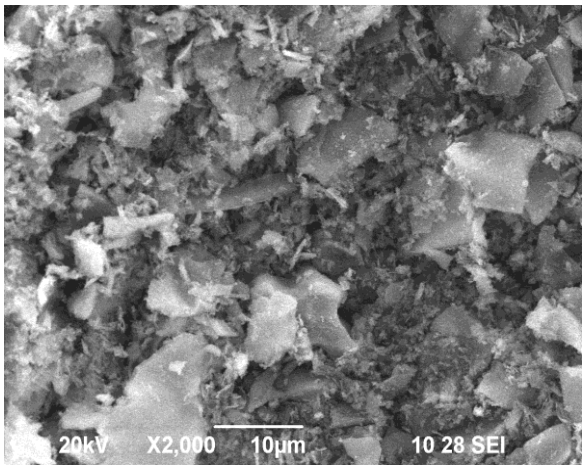

Fig8d: SEM result analysis of Leaf at X2000 magnification.

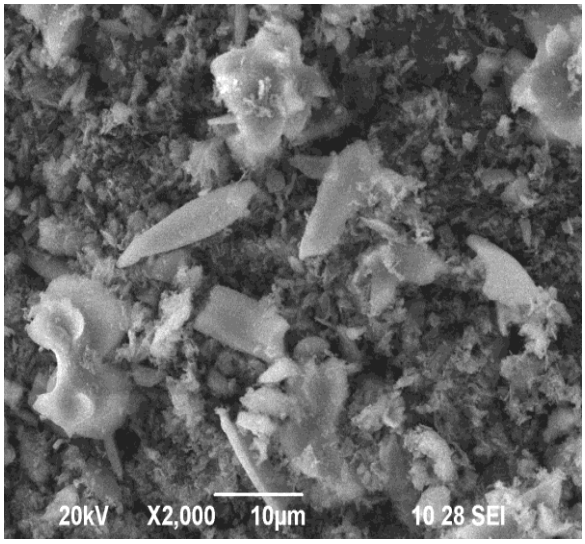

Fig9a: SEM result analysis of Husk at X2000 magnification

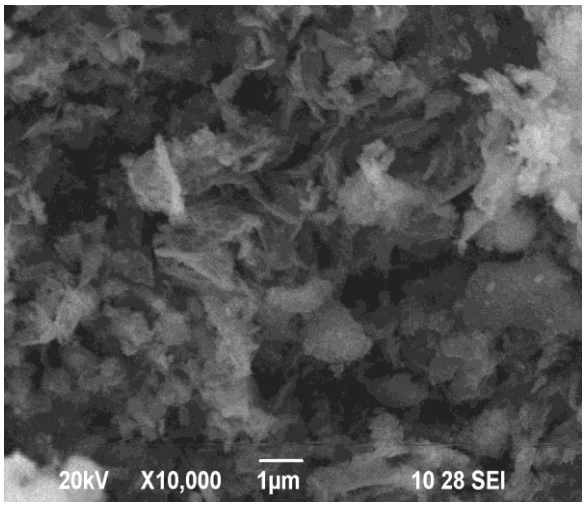

Fig9b: SEM result analysis of Husk at X10000 magnification.

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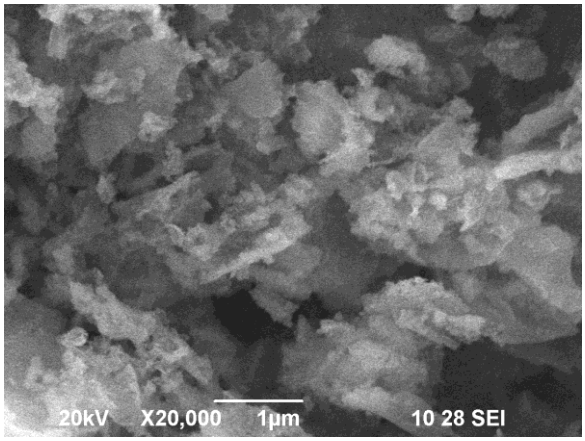

Fig9c: SEM result analysis of Husk at X20000 magnification.

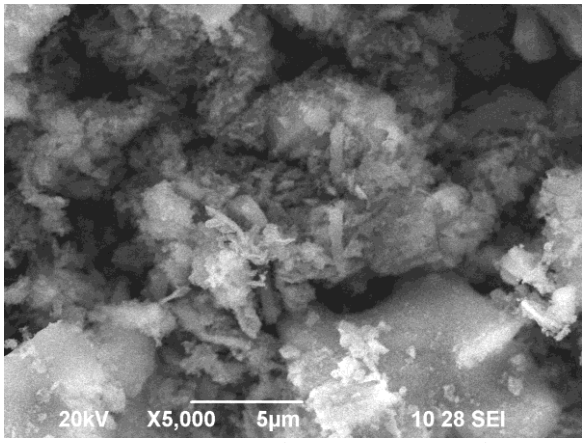

Fig9d: SEM result analysis of Husk at X5000 magnification.

5.CONCLUSION:

From the above results and discussions and also studies from the previous literatures the Zea mays plant showed the presence of more amount of silica in it. Particularly in the case of leaves when it is burned at a temperature of 625 ºC. Silica presence in leaves is about 93.87%.The EDAX and Sem analysis also confirms the % of silica and the surface morphology of the synthesized silica particles from the Zea Mays plant.

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