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Residual Silica in Raw Jute and Elimination Scope

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Abstract- Jute- the golden fibre of Bangladesh is used widely for various purposes. But it is reported that there is a draw back facing in the industrial machinery while processing the jute fibre for its product due to the presence of Residual Silica / Silicates. Under very warm condition the silicates may split into silica. Since silica and silicates are semi -metal, they exhibit conductive property in raw jute and also in jute products. An investigation was carried out in BJRI & PDB, Ghorasal Laboratory to find out the content of Residual silica /silicates by Spectrophotometric and Ashing methods in retted raw jute fiber of Faridpur zone for suggesting the remedial measure.

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Residual Silica in Raw Jute and Elimination Scope

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Abstract- **Jute- the golden fibre of Bangladesh is used widely for various purposes. But it is reported that there is a draw back facing in the industrial machinery while processing the jute fibre for its product due to the presence of Residual Silica / Silicates. Under very warm condition the silicates may split into silica. Since silica and silicates are semi -metal, they exhibit conductive property in raw jute and also in jute products. An investigation was carried out in BJRI & PDB, Ghorasal Laboratory to find out the content of Residual silica /silicates by Spectrophotometric and Ashing methods in retted raw jute fiber of Faridpur zone for suggesting the remedial measure.**

I. Introduction

Jute is an important raw material for producing paper and pulp, domestic purposes, body materials of vehicles, cloths, handicraft materials, gunny bag, etc. A long process is to follow to get the jute fibre in the hand of the user starting from its growth when there is every possibility to carry so many impurities among which Silica is one of them, and this Silica in jute creates a lot of problems [(1,3)]. Some plants contain an appreciable amount of Silica in plant tissues. The green plant only from the soil usually absorbs most of the elements other than Carbon and Oxygen. Elements that enter into a plant from the soil might be presented to it in the form of its soluble component [(2,5)]. During the last few decades, much diversity of opinions about the effect of silica on the plant growth has been expressed. It has been reported that the silicon is an element, which occurs in the plants universally and the amount of silica present in the plant varies greatly for different plants and again varies for different parts of the same plant [(1,3,4,5)]. It has been reported that the silica content is commonly found more not only in leaves but also in the stem of the plant [(5,6)]. A large amount of jute fibre is being used as raw material for paper and pulp. There is no doubt that if jute contains significant amounts of Silica in the process of pulping, it will be separated from the fibre and will appear in the black liquor (waste stem) in the form of Sodium Silicate and another complex Siliceous compound. Gradually the separated Silicate/ Siliceous compounds accumulating and causes hard Scaling in evaporator tubes and other associated parts of the recovery system, reducing their efficiency and ultimately increasing maintenance as well as production costs. Also, the other oxides/compounds along with Silica either will deposit or will cause corrosion in the machinery of the factory. The mineral matters associated with raw jute fibres are inorganic salts, oxides of metals, Silicates and Silica might be due to the contamination during retting, washing, drying, storing, marketing and, eventually transportation. On the other hand, water-soluble Silicates possess some polarity. In some specific warm condition, the silicates may split into Silica [(4,6)]. Both Silica & Silicates may disburse the conductive property of raw jute. So, it is very important to have either Silica free or the least amount of silica content in the Jute fibre to avoid the above problems. Therefore, an investigation was conducted to find out the content of silica in the jute fibre for suggesting a remedial measure so that raw jute fibre could be used in producing good quality of its product and to maintain the machinery in good condition.

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II. Materials & Methods

Retted Raw jute samples (conventional & control system) were collected from Faridpur zone. Green jute sample was taken from BJRI experimental field.

a) Apparatus

UV/VIS – Spectrophotometer, Glass wares, reagent grade chemicals, ashless filter paper etc. were used according to the need of experiment. Standard SiO_2 solution was stored in a clean dark plastic bottle.

b) Reagents

Ammonium hepta Molybdate (10% w/v), Oxalic Acid Solution (10% w/v), 1-Amino- 2- Naphthol - 4-Sulfonic Acid Solution (ANSA), 1:1 HCl acid, SiO_2 Standard Solution prepared by dissolving 0.4732 gm of $Na_2SiO_3.9H_2O$ (SiO_2 = 100 ppm), and Silica free water.

c) Procedure

To measure the content of silica- the Green Jute stick was washed and taken out the ribbon and cut into small pieces of about 2-3 cm long and was burnt in a platinum crucible and then a solution was prepared followed by fusion taking a certain quantity of ash for colorimetric (UV/VIS- spectrophotometric) analyses. Retted jute fibre was hydrolyzed using caustic & 0.1N HCl to extract both the soluble and insoluble Silica / Silicates. After hydrolysis, the jute fibre was taken out

and rinsed several times. All the rinsing water collected together. The solution recovered by filtration was used for Colorimetric determination to measure the content of soluble silica and the residue left in the filter paper was used to find out the content of insoluble silica [7]. The residue in the filter paper was treated by aqua regia to remove any heavy metal, which is not dissolved by HCl. Insoluble silica was determined by ashing method at $500^{O}C \pm 50^{O}C$ using a Platinum crucible and Muffle furnace.

The amount of insoluble Silica was the difference between the weight of dried empty Crucible and the weight of crucible after making ash as stated above. The total silica was the sum of soluble Silica and insoluble Silica. The UV/ Vis - spectrophotometer was calibrated by using 0 ppm, 2 ppm, 4 ppm, 8 ppm, 12 ppm, 16 ppm, & 20 ppm of Standard SiO_2 solution according to ASTM D-859 procedure.

III. Results and Discussion

The results of Silica determined by Colorimetric and Ashing methods – presented below in tables 1,2 & 3.

Table 1: Determination of Silica / Silicates in different parts of Green Jute plant Collected from BJRI experimental field

Serial No.	Sample type	% of Silica content as SiO_2	Sample collected from
1	Top	0.0004	BJRI experimental field.
2	Middle	0.0003	
3	Bottom	0.00031	
4	Root	0.0013	

Table 2: Determination of Silica / Silicates in Jute collected from Faridpur zone retted under conventional system

Sl. No	Sample collected atea	Collection source	Retting water Condition & Jack material used.	Washing condi-tion	Drying Condition	% of total Silica Content as SiO_2.
01	Ragunan-dnpur	Produ-cer	Stagnant water under Grass& banana logs	Turbid water	Bamboo log	0.0129
02	Nakulhati	Whole-saler	Stagnant water under water hyacinth	Clean water	Bamboo log	0.0056
03	Talma	Produ-cer	Stagnant water under banana logs	Turbid water	Bamboo log	0.0142
04	Kaniepur	Whole-saler	Stagnant water under water hyacinth	Clean water	Bamboo log	0.0118

Table 3: Determination of Silica / Silicates in jute samples collected from Faridpur zone retted under control system

Sl. No.	Sample collected area	Collection source	Retting water Condition & Jack material used.	Washing condition	Drying Condition	% of total Silica Content as SiO_2.
01	Faridpur	BJRI	Stagnant water	Clean water	Bamboo log	0.0037
02	Faridpur	BJRI	Stagnant water	Clean water	Bamboo log	0.0028

The contaminants like silica in jute can cause a significant problem for machineries. Silica accumulates and hardens on machinery creating the need to frequently stop production and clean with chemicals. Frequent shutting down machinery in mill / industry decreases the chance of creating economically viable product. Again small mills will be more affected because chemical recovery does not make economical sense.

So, it is very important to reduce the amount of Silica content in Jute fibre. From the analyses results of green jute ribbon shown in Table 1, it seems that the silica in jute by nature is very negligible which in practical might not be any problem in industries. It is easily understood from the green jute analysis that the silica in it either could be the analysis error or a trace amount of soluble Silica exists naturally. It can be concluded from the analyses results shown in table 2 & 3 that the conventional retted & retted under control system respectively - the significant amount of Silica / Silicates in jute is nothing but a result of contamination causes at the time of retting, washing, drying, storing and transportation.

a) Remedial measure

Some investigations were done to reduce the content of Silica. From that experiment the following suggestions could be adopted for remedial measures.

(1) While retting the jute- use clean water, bamboo chunk beneath the jute for jag and use concrete block Bamboo/ Wooden log on the top of jag as

weight- should not use banana log, soil chunk, water hyacinth.

(2) Wash in clean water and dry on bamboo/ wooden log instead of using open filed and store on bamboo / wooden terrace- not on the floor.

(3) If the jute looks dirty due to water contamination- shock it with 4-5% detergent for one hour, then wash out the detergent and then finally wash with 4-5% HCl acid solution for 30-60 minutes.

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