STUDY OF RESIDUAL SILICA/SILICATES IN THE RAW JUTE AND SCOPE FOR ELIMINATION/REDUCTION (CFC/IJSG/23FT)

PROJECT COMPLETION REPORT

April 2007

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Funding Agency:

Common Fund for Commodities (CFC)
Willemshuis Stadhouderskade 55
1072 AB Amsterdam
The Netherlands
Tel +31 20 575 4941
Fax +31 20 676 0231
Email: Managing.Director@common-fund.org
Website: www.common-fund.org

Participating Institutions:

Bangladesh Jute Research Institute (BJRI)
Manik Mia Avenue, Dhaka 1207
Tel: +88 02 9111658, 8121931-2
Fax: +88 02 Fax: 9118415
Email: info@bjri.gov.bd

&

Institute of Jute Technology (IJT)
35, Ballygunge Circular Road
Kolkata 700019, India
Tel: +91 33 24615444/5326/5477
Fax: +91 33 2461 5632
Email: ijt@cal2.vsnl.net.in
Website: ijtindia.org

Supervisory Body:

International Jute Study Group (IJSG)
145 Monipuripara, Tejgaon
Dhaka 1215, Bangladesh
Tel: + 88 02 9125581-5. 9124887
Fax + 88 02 9125248-9
Email: info@jute.org

CONTENTS

Synopsis

of the

Study of Residual Silica/ Silicates in the Raw Jute and Scope for Elimination/Reduction

- A detailed analysis has been carried out by various methods to find out the extent of silica content in various forms in jute plant and fibre.

- The results show that siliceous content is very low in clean jute (much below 0.02%).

- The presence of sand, dirt and dust in jute due to external contamination at different processing, handling, storing and transportation stages may increase the content of siliceous matter.

- The precautionary measures to be taken by the growers, traders and end-users have been mentioned and a Protocol has been printed for distribution among the concerned stakeholders to disseminate this information.

- It can be concluded that significantly low extent of siliceous matter found in clean jute will not be a detrimental factor in case of electrical conductivity when jute is used in manufacturing insulation paper and other similar products.

Study of Residual Silica/Silicates in the Raw Jute and Scope for Elimination/Reduction

I. Project Summary:

1. Project Title : **Study of Residual Silica/Silicates in the Raw Jute and Scope for Elimination /Reduction**

2. Number : **CFC/IJSG/23FT**

3. Project Participating Institutions:

   i) **Institute of Jute Technology (IJT)**
   35, Ballygung Circular Road
   Kolkata 700 019, India &

   ii) **Bangladesh Jute Research Institute (BJRI)**
   Manik Mia Avenue
   Dhaka 1207, Bangladesh

4. Location : **India & Bangladesh**

5. Starting Date : **01.07.06** (initially 01.10.05)

6. Completion Date : **28.02.07** (initially 31.12.06)

7. Financing:

Estimated Total Project Cost	:	**US$ 45,000**
CFC Financing (Grant) up to	:	**US$ 34,000**
IJSG Contribution (in kind)	:	**US$ 5,000**
In kind contribution of IJT & BJRI (Participating Institutions)	:	**US$ 6,000**

II. Background and Concept in which the Project was Conceived:

Jute fibre along with other bast fibres is being used as raw material for paper pulp especially in the developed countries since long.

The problem of using raw jute for pulp making especially for specialty paper like insulation paper because of apparent high level of Silica content found in raw jute was first reported to IJSG by some European buyers/traders.

The European pulp producers expressed concern on the presence of higher level of Silica in raw jute because of the stringent quality requirements in the European/developed countries. Silica content above a minimum allowed level (0.02%) would make the pulp unfit for making special insulation paper since this tends to increase the conductivity of these papers to an unacceptable level.

It was further reported that until and unless fibre can be supplied that meets the strict criteria of paper pulp makers (in other words unless a solution could be found that guarantees that silica content of the fibre would not exceed 0.02%) this market may be lost.

If fibres supplied to paper pulp producers do not meet the strict criteria of specialty pulp then they will stop using raw jute for specialty paper making and shift to other raw materials. The consequence of this development is a possible loss of an important market, and a subsequent fall in raw jute prices in the major jute producing countries.

***Commodity Strategy*:**

Taking into account the major changes that have taken place in the jute and kenaf sector during the last decades and the new opportunities likely to be created with the increasing commitment and for protecting the environment a new development strategy for jute and kenaf is in force.

The proposed Project is in compliance/accordance with one of the key elements of this commodity strategy i.e. **to develop new products using the advantages of natural fibres**. Diversified uses of kenaf/jute such as Pulp and Paper along with composites, non-woven, wood substitutes have been emphasized under this element of the strategy. It has been established that pulp for brown/normal writing paper can be made from the whole jute and kenaf plant. It is intended to also establish the suitability of raw jute fibre for making pulp for sophisticated uses i.e. high quality specialty paper through this project.

IJSG, the sponsoring ICB attaches great importance to addressing the issues that may threat existing/ possible enhancement of market share, the promotion of alternative uses of jute, maintaining/increasing the poor farmers' income etc.

***Aim of the Project*:**

To make an in-depth study on the presence of silica/silicates in raw jute and to suggest possible measures for its removal/reduction to its minimum permissible level to make such raw jute fibre suitable for producing specialty pulp and paper and other innovative jute products.

***The specific Objectives of the Project*:**

a) Traceability of silica/silicate and identification of the sources of contamination.
b) Quantification of silica and silicate in raw jute

c) Remedial measures to remove/reduce silica/silicates
d) Dissemination of these measures to farmers/exporters/traders.

***Expected outputs*:**

a) Identification of source(s) of silica contamination.
b) Assessment & estimation of quality and quantum of silica with contamination source(s).
c) Identification/development of method/technique for removing/reducing silica/ silicate from raw jute.
d) Preparing manual/protocol.

***The targeted beneficiaries and extent of benefits*:**

i. The Project is envisaged to find a solution to the problem of the presence of unacceptable levels of silica in raw jute.

ii. The proposed Project will preserve the existing market of significant tonnages of raw jute in Europe, improve the competitiveness of jute over other bast fibres for production of superior quality/speciality paper and other innovative products.

iii. It will directly benefit market share for jute of both the producing and the consuming countries (exporters/importers). The most important beneficiaries will be the jute farmers of the jute growing countries, who constitute a major portion of the population and will be benefited by steady/higher incomes.

iv. More paper pulp products from jute will help conserve forest resources thereby will provide environmental and economic benefits not only to jute producing countries but throughout the world.

v. The technical institutions and paper pulp industries will gain technical knowledge, expertise and acquire capabilities.

***Project Cost*:**

The total cost of this Fast Track project was estimated US$ 45,000 of which the Grant Fund of Common Fund for Commodities is US$ 34,000. The in-kind Counterpart Contribution of IJSG, the project Supervisory body has been US$ 5,000 whereas the participating institutions i.e. BJRI and IJT made Counterpart Contributions worth US$ 6,000 (US$ 3,000 each).

***The Management and Implementation Arrangements*:**

The Consultative Committee of CFC in its Thirty-Sixth Meeting held during 11 – 16 July 2005, reviewed the project proposal entitled "Study into the Residual

Silica/Silicates in Raw Jute and the Scope for Elimination/Reduction" and recommended it for approval.

An Agreement among CFC and IJSG was concluded in September 2005.

IJSG, being responsible for overall implementation of the project, and also as the Supervisory Body needed to enter into formal contractual arrangements with the participating institutions. Accordingly a Project Implementation Agreement was signed by IJSG and BJRI for implementation of the project activities in Bangladesh in October 2005.

Due to unavoidable circumstances, IJIRA, the participating institution proposed in the earlier Project Agreement for implementing the project in India, was replaced by the Institute of Jute Technology (IJT), Kolkata. Subsequently, a formal contractual arrangement was concluded between IJSG and IJT in June 2006. As a result actual implementation of the project was delayed and the date for completion of the six-month project was fixed on 31 December 2006, instead of 31 March 2006, stipulated earlier in the Project Agreement.

Finally to complete all project activities the project duration was extended up to 28 February 2007.

To establish a proper arrangement for implementation and management of the project, a number of meetings were held at IJSG Secretariat, BJRI and IJT with the concerned scientists and officials. Exchange of visits of the scientists from BJRI & IJT was also organised by IJSG, in consultation with CFC, to ensure better coordination and interaction among the scientists of the participating institutions.

III. Project Implementation and Results Achieved:

1. Project Implementation:

***Rationale*:**

Jute is an important natural fibre occupying second place in economic importance only to cotton. The fibre has certain important properties in the area of strength, thermal and electrical insulation. The export potential of jute is visible in certain new areas although there is a general decline in consumption of jute in conventional areas of packaging. In order to contain this unabated decline in consumption and demand for jute fibre and traditional products concerted efforts are being made to promote the best properties of jute, in which it would have competitive advantages over other fibres.

Jute is a natural vegetable fibre under the category of bast fibres i.e. flax, hemp, kenaf and ramie. Jute is an annually renewable plant belonging to the genus Corchorus of the order Tiliacea. Normally two species viz. *Corchorus olitorius* and *Corchorus*

capsularis commonly known as Tossa and White Jute respectively are produced in commercial scale.

Chemically jute is a ligno cellulosic fibre mainly composed of cellulose, hemicelluloses and lignin. Due to the presence of non cellulosic constituents (about 40%) jute is highly susceptible to chemical reagents.

The mineral matter present in raw jute is composed of inorganic salts, metal Oxides, Silicates and Silica. The two most abundant elements in earth's crust and mantle are oxygen and silicon. These two elements combine to form the molecule called silica or silicon di-oxide (SiO_2). Water soluble silicates are having some polarity. The silica which may be present in raw jute is traceable to silicates. Further under very warm condition the silicates may split into silica. Both these silicates and silica may disturb the conductive property of raw jute. In this backdrop the current project and the associated activities have been proposed.

***Project Identification*:**

In an effort to collect information from different sources as regards actual content and form of silica present in raw jute the need for a systematic in-depth study on the presence of silica in jute leading to a solution of the silica problem has been felt by the IJSG Secretariat and all concerned.

A project idea on "Assessment of Silica in Raw Jute Fibre" was placed for consideration of Committee on Projects (COP) of IJSG in its Fifth meeting. The COP in its Fifth meeting held on 16-17 February 2005 reviewed and approved the proposal.

The Committee authorised the Secretariat to finalise the proposal in consultation with the relevant R&D institutions of Bangladesh and India, to be involved in the project, and approach CFC for funding. Subsequently, the present project profile was finalised.

***Project Initiation*:**

With the signing of the Project Agreement between CFC and IJSG the project was initiated at the end of September 2005. The IJSG concluded a formal Contractual Agreement between IJSG & BJRI and IJSG & IJT for implementation of the project activities in Bangladesh and India respectively.

Due to change of participating institution for India part of the project, actual implementation of the project activities in India could not be started before 01 July 2006.

***Efficiency and Effectiveness of project Implementation, Management & Supervision*:**

The Bangladesh Jute Research Institute BJRI) and the Institute of Jute Technology (IJT) were assigned with the responsibility for undertaking the studies comprised by the project.

The project has been implemented in India and Bangladesh as per terms and conditions, project objectives and operational arrangements outlined in the project documents and formal agreements, made by all parties i.e. CFC, IJSG, BJRI and IJT.

As Supervisory Body (SB), IJSG has been constantly in touch with the participating institutions, closely co-operated with them by rendering advisory services and guidance. IJSG made all efforts for continuous monitoring and supervision by using various formal and informal modes of communication with the concerned parties for overall implementation of the project activities.

To establish better co-ordination and interaction among the participating institutions and the SB, a number of meetings were held in Dhaka and Kolkata by IJSG Secretariat with the concerned scientists of BJRI and IJT.

IJSG has kept CFC informed of all developments and consulted with CFC as and when necessary.

As proposed by IJSG, in consultation with CFC, there had been exchange of visits of scientists of IJT to BJRI and BJRI to IJT for fruitful interaction, exchange of knowledge, expertise and better co-ordination among the core people involved in the study for ensuring successful implementation of the project.

***Resource Utilization*:**

Out of a total approved CFC grant of USD 34,000 (maximum) for the project, the disbursement of an advance of USD 30,000 only was made available to IJSG by CFC in accordance with the provisions of Schedule 1, enclosed in the Project Agreement.

On formal request and submission of bank details of designated Bank Accounts (with signatures of authorised operators of the account) opened by the participating institutions i.e. BJRI and IJT, they received CFC grants through IJSG for implementation of the project.

So far, **USD 10,000** and **USD 15,568** have been disbursed to BJRI and IJT respectively by IJSG, for implementation of the project activities, out of an advance of **USD 30,000** received from CFC as project grant.

2. Project Results Achieved:

The project activities have been carried out as per detailed Work plans /activity schedules (given as **Annexure 1a & 1b**) under the three major components viz. i) Supply Chain Analysis, ii) Chemical Analysis of Samples, and iii) Remedial measures for removal of Silica.

The main activities of the project are briefly described below:

a) Collection of samples of jute plants (different stages of growth) and jute fibres from different places /sources

In accordance with the detailed work plans submitted by IJT and BJRI for implementation of the project in India and Bangladesh respectively, jute and its related samples were collected from different stages of its growth and from different areas of jute growing zones. All the samples were collected for analysis of silicon content in them for the purpose of identification of source(s) of such silicon contamination in jute.

Samples of retted jute following conventional and controlled retting techniques along with samples of soil and retting water were also collected for analysis of silica content. In the controlled retting technique, all measures were taken to avoid silica contamination from every stage of retting, starting from making bundles of jute plants, called 'Jak', placing the bundles in the water, using weighting materials to keep the jute bundles (Jak) submerged in the surface water, in extracting and drying these raw fibers.

After collecting the samples of jute sticks, leaves, fibres, water etc. these were put in polythene bags to keep these free from contamination of dust/dirt etc. Jute fibre samples were collected also from different secondary markets and mill godowns.

Details of collection procedures of samples are given in **Annexure 2a & 2b**.

b) Review of relevant literature to have information regarding possibility of up take of silicon/silicon compounds by jute plant

Information on uptake of silicon/silicon compounds from soil by jute plant and report of analysis of jute for silicon content in them are scanty. In view of above, a survey of relevant literature to this project was independently made by BJRI and IJT which are given in **Annexure 3a & 3b**.

c) Identification of suitable methods for quantitative estimation of Silicon/ Siliceous matters

The standard methods for analysis of silicon/siliceous matters in plants were identified after a thorough study on reproducibility of these results encompassing range of equipment, reagents and personnel skill involved at different laboratories. Such methods are based on 1) Colorimetry using UV-Vis spectrophotometry and 2) Graphite furnace atomic absorption spectroscopy.

For IJT chemical analysis based on atomic absorption spectroscopy followed by the method of USEPA:3052 was done by the Laboratories of West Bengal Pollution Control Board, India. The Colorimetric estimation using UV-Vis spectrophotometry was done by an internationally accredited laboratory in the field of chemical testing in Kolkata (in accordance with the standard ISO/IEC/7025:2005).

In BJRI the analyses were carried out in its chemistry laboratory as well as in the laboratory of Power Development Board, Ghorasal, Bangladesh mainly based on the UV-Vis spectrophotometry following ASTM D-859. Retted samples were analyzed to find out the content of silica / silicates by Fusion and Ashing method.

In order to identify a suitable chemical treatment and to optimize a set of conditions of such chemical treatment as required, for reduction of siliceous matters in jute, study on chemical treatment of jute, employing dilute acid and alkali in a sequential manner as specified in the result, was carried out by both BJRI and IJT in their analytical chemistry laboratories.

d) <u>Chemical analysis to assess the presence of actual amount of silica</u>

Experimental details of analytical methods adopted, preparation of the specimens and chemical treatments done are given in **Annexure 4a & 4b**. Results achieved, in the tabular forms along with detailed discussions are given in the **Annexure 5a & 5b**.

The **results/ findings** from the above chemical analyses may be interpreted as follows:

→ From the analysis of different organs of jute plants at different stages of its growths, it is found that there is a slight variation of silica content, expressed in percentage of silicon dioxide in 100 g of dry sample (**Table 7, Annexure 5a**).

→ The content of the siliceous matters in different organs of jute plant such as, plant root, stick, jute fibre and leaf follows a common increasing trend with increasing periods of growth of the jute plants in the field (**Table 1a – 3a, Annexure 5b**).

→ Most of the jute fibres and jute sticks attained the maximum content of siliceous matters when extracted by retting from the plant and analyzed without giving any prior wash in the laboratory.

→ A common decrease in the content of silica/silicates (much below the maximum permissible limit specified by pulp producer) resulted from the washed jute fibre and jute stick extracted from the jute plant by the process of control retting (**Table 1a, Annexure 5b**).

→ The results found in the analyses showed that in most of the samples the content of silica were in the range of 0.001 - 0.02% which are within the acceptable limit (**Table 1 - 7, Annexure 5a**).

→ Jute fibres and sticks after retting, when washed thoroughly prior to estimation of silicon content in them, it reduced to the range of 10^{-3} g from the range of 10^{-2} g found for unwashed retted fibres and sticks [much below the maximum permissible limit (0.02%)].

→ Data obtained for silicon content following AAS appear to lie closely to those obtained following colorimetric estimation of respective samples, for most of

the samples silica content are in the range of 10^{-2} g or 10^{-3} g per 100 g of dry sample (**Table 1a/1b – 3a/3b**, **Annexure 5b**).

→ The increase of silica content appeared to be due to external contamination resulted from retting, washing and in course of drying, grading, baling, handling, transportation, storing, etc. (**Table 5**, **Annexure 5b**).

→ Unwashed jute fibers obtained from the market and jute mill were found to contain maximum silica level, from which, except one sample, it was possible to reduce silica content to an acceptable range by simple washing (**Table 6, Annexure 5b**).

→ Silicon being second most abundant element in the earth's crust widely occurs in clays, mineral, dirt, dust and water and it is hardly possible to have chemical reagents, water and even the equipment and apparatus, to be used for estimation, completely free from this element.

→ Results obtained for silicon content of jute fibres and related samples following the above methods can be considered to be in good agreement with each other.

e) <u>To explore the possibility of reduction/removal of siliceous matters from jute</u>

From the trend of data obtained for silicon content in jute collected at different stages as discussed (**Annexure 5a and 5b**), it appears that jute gets contaminated with only extraneous siliceous particles to an unacceptable level in processes related to transportation, gradation and baling.

Such contamination appears to be highly probable particularly in the process related to grading of jute fibres, where individual jute reeds are placed (spread) on the floor already having large quantity of fine dirt and dust (shredded from the previously examined reeds) for examination of the same. Such examined jute reeds with loosely adhering fine dust and dirt after being sorted and graded, when compacted and compressed in baling machine under high pressure, fine subdivisions of adhered dirt and dust get mechanically entrapped on the irregular surface of jute fibre which has its sharp intercellular regions between unit cells with cracks and crevices; such adherence of dirt and dust therefore makes sometimes subsequent removal of them difficult, by a simple washing process.

Substantial difference between the silicon content of jute collected immediately after retting and that of jute collected from the market (**Table 5 & 6**, **Annexure 5b**) is therefore to be understood taking the above facts into consideration.

Effect of selective chemical treatment on removal of residual silicon from Jute:

In order to assess the efficacy of different chemical treatments on removal of silicon from jute, jute fibres obtained from market having silicon content in the range of 0.0187-0.026 g/100 g was subjected to sequential mineral acid and alkali wash (as specified in **Table 7**, **Annexure 5b**) by IJT in its analytical chemistry laboratory. BJRI also conducted some experiments on a jute sample with silica content of

0.0202 g/ 100 g for its removal or reduction to an acceptable level (**Table 8, Annexure 5a**).

Chemical treatment with either of 40 g/l sodium hydroxide or of 80 g/l of sodium carbonate for a duration of 1 h, followed by washing, neutralization with dilute (N/10) hydrochloric acid and further washing reduced silicon of jute to substantially low levels and on overall assessment either of such treatments appears to produce optimum or the most balanced effects in removing silicon from jute, when economics of such treatments are taken into consideration.

f) <u>Preparation of manual/protocol to disseminate knowledge for removal/ reduction of silicon contaminant from jute</u>

One of the main objectives of the study is to suggest possible measures for removal/reduction of the content of silica, if found as alleged, to its minimum permissible level to make such raw jute suitable for producing specialty pulp and paper and other innovative jute products.

To eliminate/minimize the problem of silica contamination by way of creating awareness amongst all concerned in the jute sectors of both Bangladesh, India and the overseas consumers about the source of silica contamination and the possible measures to avoid fully or partially such contamination, development and printing of a Protocol in three languages (English, Bengali & Hindi) for making jute free from silica contamination has been envisaged.

The Protocol would mainly indicate the probable sources of silica contamination and suggest measures to be taken by farmers/growers, traders, processors & product manufacturers in respective stages of processing/handling etc. to remove/reduce the level of silica in the fibre.

The Protocol is expected to serve as a useful guide to the potential users of the jute sector. A draft of the Protocol (English version) prepared by IJT is enclosed as **Annexure 6**.

3. Dissemination of the Project results*:*

The results and outcome of this study may be disseminated as follows:

(1) Printing of a Protocol/Manual in English, Bengali and Hindi languages to be printed and distributed among the farmers, balers, graders/sorters, traders etc. in various parts of India, Bangladesh and to the consumers of the Western /developed countries.

(2) A Project Completion Report based on the findings and results obtained by both IJT and BJRI to be forwarded to CFC.

(3) Seminar/discussion meeting (s) may be organised.

(4) Suitable slogans, banners, festoons, leaflets may be published and distributed among the farmers, traders and other stakeholders for developing awareness about the importance of silica contamination free raw jute/ jute fibre.

(5) The project results may also be disseminated through publishing popular articles in Newspapers, Magazines etc.

IV. Lessons Learnt:

1. This report is based on the analyses of jute plants cultivated in the soils of different places already prepared and dressed under the supervision of jute growers who were not aware regarding such study. As a result, essential control needed during addition of nutrients, manure etc. to the soil could not be achieved in our study to establish a relationship between silicon content in soil and that in jute.

2. In collecting jute samples from different jute growing areas of Bangladesh and India it appears that the farmers are not careful and attentive to get jute fibre, free from unwanted impurities like, dirt, sand/mud and other possible contaminants that may affect the ultimate product quality. It is, thus, necessary to develop/grow interest, knowledge and awareness among the jute growers/handlers/traders regarding these problems in order to have silica contamination free jute fibre, which would ultimately benefit them economically.

3. For quantitative estimation of compounds of silicon in plant at the micro level, it is essential that the laboratories engaged in such a study should develop its own expertise first, by a reproducible study encompassing the range of equipment, reagents and personal skill involved in such estimation to be definite to get the results within an acceptable accuracy level. Time needed for carrying out such a study is of vital importance for the success of the project and should be included in the project duration.

4. Selection of method for analysis of silicon in jute should be made keeping the effects of well known `matrix matching´ [45] (**Annexure 3b**) in view.

5. The`memory effect′ [45] for use of Graphite furnace atomic absorption spectroscopy should be kept minimum during analysis of large number of samples of jute for silicon content, by frequently replacing old graphite tube furnace by a new one, to get the result within a reasonable level of accuracy (**Annexure 3b**).

6. It reveals from the analyses that silica/silicate does not exist in jute fibre neither as an essential constituent part of ribbon nor as absorbed soluble silica from the soil. The presence of a trace amount of silica in the analyses of green jute ribbon (**Annexure 4b**) is an experimental error due to instrument calibration, handling, measuring etc.

7. In the analyses a major part of the silica removed by successive washing with caustic and acid treatment was in the form of soluble silica that comes from contaminated

water while retting and washing. It is seen that the content of soluble silica in jute fibre varies from place to place depending on water source - higher the silica present in water higher the silica adherence in jute fibre from water. Insoluble silica is coming from turbid water, drying methods, handling, transportation and storage.

V. Conclusions and Recommendations:

1. Jute, like other plants absorbs silicon from the soil in the forms of water soluble silicate salts of alkali metals and silicic acid.

2. In most of the samples the content of silica was in the range of 0.001% - 0.02% i.e. within the acceptable limit.

3. The results show that siliceous content in clean jute is very low (much below 0.02%).

4. Colorimetric estimation and analysis based on atomic absorption spectroscopy show that the silicon content of unwashed retted jute owing to the presence of such water soluble siliceous matter becomes marginally higher than the maximum allowable limit of 0.02%, which can substantially be reduced, much below the above limit by a simple wash in clean flowing water.

5. Jute fibre strand appears to be contaminated with extraneous siliceous matters during transportation, grading and baling which leads to enhancement of silicon content of unwashed fibres above the acceptable limit of 0.02%. A simple wash with clean water removes most of such contaminants from jute, thereby reducing silica content of washed jute below acceptable limit.

6. Sequential treatments with aqueous alkali (20-40g/l sodium hydroxide or 50g/l sodium carbonate) at room temperature for 1h, wash, neutralization with N/10 hydrochloric acid followed by further wash with water, removes more than 80% of associated siliceous matter from jute. Such treatments render jute fibres to have silicon content in the range of only 0.002-0.005g /100g, when examined and analyzed by colorimetry and atomic absorption spectroscopy.

7. In view of the facts, that jute gets contaminated with extraneous siliceous matters to an unacceptable level and also in view of extreme difficulty in handling jute in a completely isolated manner during transportation, gradation and baling, it is justified to subject the jute either to a treatment with water or to sequential treatments with alkali, acid and water as mentioned above depending on its initial silicon content, immediately before, the jute is considered for making pulp from it.

8. Washing of jute should be done using clean water, preferably following a counter current principle, which will minimize the contact of washed jute with the wash liquor, thereby allowing minimum re-deposition of siliceous matter on the washed jute.

The pulp and paper manufacturers and the composite manufacturers should be careful during the use of jute fibre in their respective areas and should take the following precautionary measures:

- ✓ For a visual test of excessive silica/sand presence, buyers should check on the spot for any unwanted adhered loose silica/sand in jute fibre by shaking some quantity of jute (taking from seller's stock) on transparent polythene or paper where adhered silica/sand will be collected and following remedial measures may be taken, as appropriate.

- ✓ Before stapling the jute into required length by a cutting machine, the jute reeds or the breaker/finisher carded slivers should be passed through the shaking device for proper dusting off the extraneous dust and dirt from the jute fibre.

- ✓ If possible the fibre strands or roots from the field should be washed thoroughly, dried and then placed on a shaking device.

- ✓ After stapling, the fibrous mass should be cleaned in water in a sieve before it is to be fed for the pulp making process. Similarly, for using in manufacturing composite, fibres should be passed through some opening device especially by air circulation.

- ✓ Following the above techniques, the extraneous siliceous matter may be dusted off to complete/partial removal.

To avoid the presence (contamination) of siliceous matters in various post harvest processing /handling stages the following precautions should be taken by the jute farmers/ growers, the traders, balers, graders etc.:

- Jute plant should not be retted in too turbid water using water hyacinth, muddy weighting materials etc.

- Retted fibers should be washed in clean water. The washed fibre should not be kept on the muddy ground.

- Washed fibre must be dried in the sun light by hanging on bamboo/wooden frames but not spreading on road sides /fields.

- The fibre should not be dressed or stored on sandy soil and dirty place.