EU BAT ASSESSMENT

TANGSHAN SANYOU GROUP

located in Tangshan HEBEI, COUNTRY: China

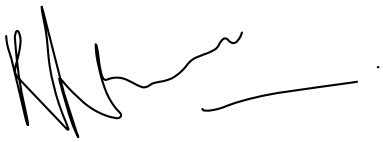
Sustainable Textile Solutions **9/23/19**

Sustainable Textile Solutions (STS) is a division of BluWin Ltd. (based in the UK). Solutions offered are clustered around the six cubes regenerative by design, sustainable fibers, processing excellence, clean chemistry, zero discharge of hazardous chemicals and climate positive. Each cube comprises impactful services which were developed with the objective to reduce the environmental footprint of the textile, leather, apparel and footwear production.

An interdisciplinary team of 50+ chemical engineers, dyers, textile & leather engineers, psychologists, environmental scientist, data analysists and economists give STS the unique position to derive innovative ideas and translate them to robust programs which drive the transformation of the apparel & footwear industry towards more sustainable production.

The multilingual global expert team is based in the key sourcing regions and works in 40+ countries.

For more information Visit us @www.sustexsolutions.com **| Follow us on** in



ROSHAN KUMAR SAH

Sr. Consultant

Sustainable Textile Solutions

Mumbai , India

EU BAT Assessment Report

Table of Contents

(1) Introduction

TANGSHAN SANYOU GROUP is one of the largest suppliers of MMCF in china. They are known for their product versatility at the Facility and committed to reducing the environmental impact of Viscose production.

Tangshan Sanyou Group Xingda Chemical Fibre Co. Ltd, & Tangshan Sanyou Yuanda fibre co. ltd as a subsidiary of Tangshan Sanyou Group, is in Caofeidian new district, Tangshan, Hebei Province, China, adjacent to Jingjintang urban group. It has a sub-company named Tangshan Sanyou Yuanda Fiber Co. Ltd. and has occupied area of 61.3 hectares.

The first production line of the company was formally put into operation in 1998. For nearly twenty years, facility has continued the technological innovation and obtained more than 60 patents. The facility has one of the world's largest production single line of viscose staple fibre with a production capacity of 80 thousand tons each year.

It was observed that the company has been identified as "National Circular Economy Pilot Units" 、 "National Hi-tech Enterprise" and "Fibre Engineering Technology Research Centre in Hebei Province"

(2) Purpose and Scope of Assessment

Sustainable Textile Solutions was tasked to conduct an assessment at TANGSHAN SANYOU GROUP on 23rd Sep. 2019 with the following objective:

(1) Measure the ecological impact of production
(2) Identify the current level of application of EU Best Available Technologies
(3) Identify gaps against EU BAT requirements

The following activities were undertaken:

(1)Primary Data Collection by the production unit in preparation for the on-site assessment
(2)On-site assessment
a) Opening Meeting

b) Factory Tour

c) Secondary Data Collection

d) Closing Meeting

(3)Data Analysis

(4)Report Writing

To validate the application of EU BATs the following data were collected and analysed:

Resources and Process efficiency

- Fresh Water Consumption (M3/TF)
- Steam Consumption (MT/TF)
- Power Consumption (KWH/TF)
- Sulphur Emission
- CS_2 Emission

Utility Efficiency

- Waste water discharge (M3/TF)
- COD Load (Kg COD/TF)

(3) Facility Overview

TANGSHAN SANYOU GROUP Xingda Chemical Fibre Co. Ltd & TANGSHAN SANYOU Yuanda fibre co. ltd based in HEBEI, China is a producer of Viscose and holds strong knowledge and experience in production process. Facility was having three plant having 5 ,4 and 2 spinning lines respectively. Facility purchase steam and power from their own group company in the industrial zone. Facility purchase CS_2 & H2SO4 with approximately 150 & 1500MT/day respectively.

Plant 3 is having One chimney tower of height 160 mts. and Plant 1 & 2 have two towers of 120 mts.in each facility.

Facility Name	TANGSHAN SANYOU GROUP, XINGDA chemical fibre Co., Ltd & TANGSHAN SANYOU Yuanda fibre co. ltd
Address	No. 6 Hope Road, Nanpu Development Zone, Tangshan, Hebei Province
Key Clients	H&M, Uniqlo
Number of Workers	5500
Product Range	Viscose, Modal, Lyocell, bamboo, Non-Woven, Special fibres
Production Volume	800,000 MT/Year
Processes	Viscose & Fibre production
Certificates	FSC-Chain of custody, ISO-14001, ISO-9001

Process Flow Chart:

Facility have only pilot line for Lyocell production in Plant 2
The raw material in this unit is pulp and process starts as follows

There are two modal production lines with production capacity of 25000 MT/a in Plant 1. Modal fibre is made of 100% high-quality wood pulp with specific process control. The discharged waste water and waste gas from modal production line are mixed with other production lines for common treatment.

VISCOSE STAGE

Steeping of wood pulp – Process carried out in pulper with caustic soda, where the pulp was fed in auto dosing system and mercerized instantly.

$C_6H_9O_4OH + NaOH \rightarrow C_6H_9O_4ONa + H_2O$ .....1)

Shredding – Pressed Slurry was added for Shredding followed by Ageing.

Ageing – In this process shredded alkali cellulose is slowly rotated in a drum for 4-6 hrs. In this process the DP (Degree of polymerization) of Fibres gets reduced to required levels. Afterward it passes through Xanthation step.

Xanthation & Dissolution – The Aged alkali cellulose is made to react with Carbon disulphide under vacuum in xanthator, which is later dissolved in caustic soda. The xanthator is then exhausted and the resultant slurry is dropped into dissolver for thorough dissolution.

$$C_6H_9O_4ONa + CS_2 \rightarrow C_6H_9O_4OCSSNa + Na_2CS_2 \text{ .....2)}$$

Ripening filtration & De-Aeration - This system consists of blenders, receivers, filtration and de- aerator.

$$C_6H_9O_4OCSSNa + NaOH \rightarrow \text{Viscose Solution (Mixing) .....3)}$$

$$C_6H_9O_4OCSSNa + H_2O \rightarrow C_6H_9O_4OH + CS_2 + NaOH \text{ (Ripening)..... 4)}$$

EXTRUSTION STAGE

Spinning – Wet spinning takes place by coagulation of filtered and deaerated viscose in spin bath which consists of Sulphuric acid, Zinc and Sodium sulphate. This process can produce the Fibre count from 1.2 to 0.6 denier.

$$C_6H_9O_4OCSSNa + H_2SO_4 \rightarrow C_6H_9O_4OH + CS_2 + Na_2SO_4 \text{ .....5)}$$

Facility does have one line dedicated to Modal fibres which has comparative high Wet modulus with respect to viscose but consumes higher energy ,chemcais and water usage compared to Viscose.

(4) Methodology

To meet the objective, we identified and validated both short- and long-term projects carried out by facility with respect to the environmental impact and the respective parameters for benchmarking as per EU BAT and applicable MMCF requirements.

Focus areas considered for this assessment are: Energy, Air emission and traceability from timber to fiber.

The site has totally five Viscose manufacturing lines. The lines were fully in operation.

The data Evaluated were from CY19 Q1 & Q2 (Jan 2019 – Sep 2019)

Formulae used

Energy Intensity: Electric and steam energy combined to form the total intensity in gJ/MT of fiber production is calculated as:

$$\frac{[\{\text{Power (KWH)x } 1.299 + \text{Steam (MT) x } 0.1128\} \text{ x } 4.2 \text{ x } 7000\ ] \text{ (gJ/MT)}}{1000000 \text{ x Total production (MT)}}$$

Air Emission: CAP (Carbon Adsorption plant) + Towers (Chimney)

CAP generate CS_2 Emission and Tower contributes to concentration of H_2S & CS_2

CS_2 Emission calculation based on the concentration of CAP and Tower Sulphur Emission Calculation is based on Mass balance for CS_2 & H_2S from air emission

Traceability: Audit report of FSC Chain of Custody (COC), Canopy audit and SFI information.

(5) Data Verification

The data analysis has been conducted for the following timeframe:

Fibre Production & Salt production - Jan to Sep 2019

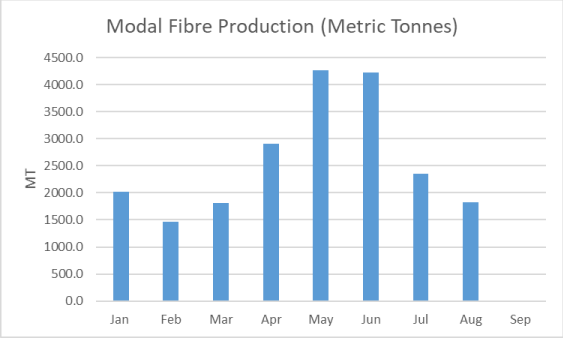


Fig - 1

Plant 1 is oldest and small spinning lines with limited scope to increase the production and salt generation as by product (Refer Annexure). In September , there was no modal production registered.

(6) Environmental Impact

6a) Energy

Normalized Power Consumption: Jan 2019 – Sep 2019 (Refer Annexure)

The energy (Electric and steam) monitoring set up at Plan 1 (Modal) are purely traditional and have limited scope to reduce further.

6b) Water

Plant 1 have dope dyeing, modal and Flame resistance fibre production, which change the water proportion comparatively in total usages. Plant 1 do have production of viscose fibre for non-woven application which increase the water usages.

6c) Air Emission

The data analysis has been conducted for the following timeframe:

CS_2 emission – Jan 2019 – Sep 2019 (Refer Annexure)

Sulphur emission is mainly controlled by CAP installed after lines as abatement technique which is an additional set up. All plants have the same control technology in line and process was efficient & effective .During desorption stages some time it shows slightly more emission, but it mainly works in range than a specific number.

6d) Waste Water

Waste water & COD load– Jan 2019 – Sep 2019 (Refer Annexure)

COD load to wastewater was quite linear and controlled.

(7) Modal Data Comparison With EUBAT

Data Comparison	Unit	Modal	EU BAT
Energy Intensity	GJ/MTf#	✓	20-30
Pulp Use	MT/MTf	✓	1.035-1.065
*H_2SO_4	MT/MTf	✓	0.6-1.0
*NaOH	MT/MTf	✓	0.4-0.6
CS_2	Kg/MTf	✓	80-100
COD Load**	kg COD/TF	✓	3-5
*Zn	Kg/MTf	✓	2-10
Process Water	M3/MTf	✓	35-70
S to Air	Kg/MTf	✓	12-20

Table - 1

MTf- Metric Tonnes fibre

*There is no seprate modal line to calculate the specific consumption/recovery. Given values are indication of overall fibre production

** COD Load – Facility is Indirect discharge

(8) Observations

1) Production

Observation

Facility have five spinning lines. Facility produce Modal,Bamboo fibres, non-woven, recyclable textile fibre and some special fibres. Total capacity of Plant 1 site is more than 120,000 MT/Year. (Fig 1) Majority of production belongs to viscose and remains are need based. Modal 25000-30000MT/Year, Anti Fire -6000 MT/year, Non-Woven 130,000 MT/year, Bamboo fibre – 10,000 MT/year and special fibre 35000~40000 MT/Year.

2) Traceability

Observation

The site has FSC® (Forest Stewardship Council®) Chain of Custody (COC). The FSC® certification ensures that the materials and products have been checked at every stage of processing and the wood within the product comes completely from FSC-certified sources from well-managed forests. In-line facility production traceability was verified from pulp to fibre production using production records. FSC certified wood is used for viscose and 100% credit, FSC Mix and FSC controlled for wood pulp and can be passed on the customers as per their request.

3) Environmental Impact Parameters

Observation

Facility consider mass balance for calculation of sulphur from CS2 and H2S emission. Each facility has their own WWTP for pre-treatment, but it has indirect discharge to common WWTP. Facility do have access to the reports of Common WWTP and COD discharge limits are well under EUBAT and Local pollution control limits.

4) Salt recovery

Observation

As indicated in spinning bath chemical reaction, process generates sodium sulphate (Na2SO4) (Reaction -5) salt as by product which is recovered and is useful to other industries. It is important to optimize the recovery of the salt as per stoichiometric reaction step, to ensure reduced load on effluents. With increase of production, the quantity of salt increased, and the salt recovery has been maintained at a consistent level.

5) EUBAT

Observation

It has been observed that the facility is well in the range of EUBAT norms of viscose production in all cases though it is in industrial zone and have indirect discharge.

(9) Conclusion

Sustainable Textile Solutions was tasked to conduct EU Best Available Technologies (BAT) Assessment at FACTORY NAME on DATE with the following objective:

(1) Measure the ecological impact of production

(2) Identify the current level of application of EU Best Available Technologies (BAT)

(3) Point out gaps against EU BAT's

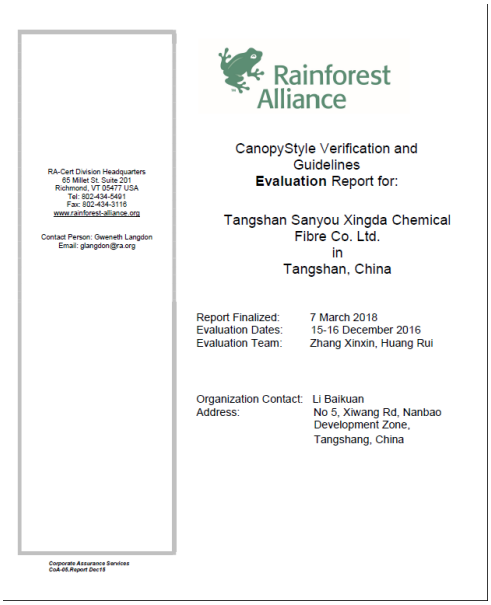
It can be concluded that:

(1) ECOLOGICAL IMPACT OF PRODUCTION – Facility following local requirements for controlling ecological impact for viscose production. Facility as well in level 3 for STeP for chemical management and Environment performance.

(2) CURRENT LEVEL OF APPLICATION OF EU BATs

The energy intensity & Air emission for the facility is well under EUBAT norms for viscose production.

(3) GAPS AGAINST EU BATs: There were no GAPs identified against EUBATs.



RA-Cert Division Headquarters
65 Millet St. Suite 201
Richmond, VT 05477 USA
Tel: 802-434-5491
Fax: 802-434-3116
www.rainforest-alliance.org

Contact Person: Gweneth Langdon
Email: glangdon@ra.org

Rainforest Alliance

CanopyStyle Verification and Guidelines
Evaluation Report for:

Tangshan Sanyou Xingda Chemical Fibre Co. Ltd.
in
Tangshan, China

Report Finalized: 7 March 2018
Evaluation Dates: 15-16 December 2016
Evaluation Team: Zhang Xinxin, Huang Rui

Organization Contact: Li Baikuan
Address: No 5, Xiwang Rd, Nanbao Development Zone, Tangshang, China

Corporate Assurance Services
CoA-08.Report Dec18

Canopy Audit

OCCUPATION HEALTH & SAFETY MANAGEMENT SYSTEM CERTIFICATE

TANGSHAN SANYOU GROUP XINGDA CHEMICAL FIBER CO., LTD.

Valid date: Apr 19th, 2018—Apr 20th, 2021

Issue Date: Apr 19th, 2018

ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATE

TANGSHAN SANYOU GROUP XINGDA CHEMICAL FIBER CO., LTD.

Valid date: Apr 19th, 2018—Apr 20th, 2021

Modify Date: Jul 13th, 2019

ISO 14001 & OSHAS

OEKO-TEX®
CONFIDENCE IN TEXTILES

CERTIFICATE

Company

Tangshan Sanyou Yuanda Fiber Co.,Ltd.
Nan Pu Development Zone
063305 Tangshan, CHINA

OEKO-TEX® STeP
18001099 TESTEX AG

SCORING RESULT STeP — LEVEL 3

CHEMICAL MANAGEMENT
ENVIRONMENTAL PERFORMANCE
ENVIRONMENTAL MANAGEMENT
SOCIAL RESPONSIBILITY
QUALITY MANAGEMENT

certificate is valid until 31.01.2022

OEKO-TEX® Association | Genferstrasse 23 | P.O. Box 2006 | CH-8027 Zurich

STeP OEKO TEX

OEKO-TEX®
CONFIDENCE IN TEXTILES

CERTIFICATE

Company

Tangshan Sanyou ... Chemical Fiber Co.,Ltd
Nan Pu Development ...
Tangshan City, Hebei, ...
CHINA

OEKO-TEX® STeP
17001302 TESTEX

is granted authorisation according to STeP by OEKO-TEX® to use the OEKO-TEX® mark for its facility.

Scope

Wet spinning and packing

Auditing and assessment of above mentioned facility meet all requirements of STeP by OEKO-TEX®. The holder of the certificate has declared to the auditing institute

TESTEX

to run the production site according to the requirements of STeP by OEKO-TEX® and its 6 modules during the period of validity of this certificate: chemicals, environmental performance, environmental management, social responsibility, quality management and safety.

The certificate is valid until 31.05.2021

...th, 30.05.2018
OEKO-TEX® Association
Secretary General OEKO-TEX®
Georg Dieners

TESTEX Swiss Textile-Testing Ltd.
Lead Auditor for STeP by OEKO-TEX®
Adrian Meili

OEKO-TEX® Association | Genferstrasse 23 | P.O. Box 2006 | CH-8027 Zurich

STeP OEKO TEX