



**LivaEco™ -**  
**Technical Evaluation and Verification of**  
**Key Sustainability Performance Indicators**  
**LivaEco™ -关键可持续性绩效指标的技术评估和验证**

prepared by

**Sustainable Textile Solutions**

for

**Birla Jingwei Fibres Company Limited, China (BJFCL)**  
**Birla Jingwei Fibres 有限公司, 中国 (BJFCL)**

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The STS programs cover the following service areas: Chemical Management, Process Optimizations, Wastewater Management, Environmental Management, Education and Capacity Building. These are designed as bespoke single projects or long-term programs to meet the individual requirements of each client.

STS has team of more than 45+ experts globally who are dedicated to enable brands and retailers to understand, communicate, monitor and improve the capability of their supply chains and achieve compliance to their environmental, health and safety standards.

Sustainable Textile Solutions (STS) 成立于 2012 年，拥有丰富的染料和化学品知识以及数十年的湿加工生产技术专业知识。

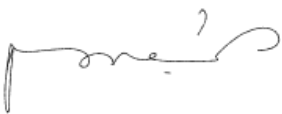
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## 1 Introduction 導言

The Aditya Birla Group is the world's largest producer of Viscose Staple Fibre. Birla Cellulose creates the highest quality, eco-friendly Fibres in the world. The Group strives continually to improve their products and progress in ways that benefit the customers, consumers and the environment. In the novel initiative for the group sustainability journey, Birla cellulose come up with new concept of LivaEco™ purely based on indigenous process and product development

The theme for LivaEco™ can be taken from various benefits of this product. The Closed Loop Technology has been applied in the viscose manufacturing process and are continually improved in order to optimize the consumption level of all raw materials and to recover and recycle as much as possible. The 3R concept is applied for conservation of water, reduce consumption, reuse the water several times, and recycle the waste water after treatment. For energy, the consumption of energy per ton of Fibre is reduced by improving the efficiency of the manufacturing processes as well as improvement in efficiency of boilers and turbine, reducing losses in the system and by recycling of waste heat.

The Aditya Birla Group 是世界上最大的粘胶短纤维生产商。Birla Cellulose 生产出世界上优质、环保的纤维。集团致力于不断改善其产品并以有利于客户、消费者和环境的方式取得进步。在集团可持续发展之旅的新倡议中，Birla Cellulose 提出了纯基于本土工艺和产品开发的 LivaEco™ 新概念。

LivaEco™ 的主题可以从该产品的各种好处中获得。将闭环技术应用于粘胶生产过程中，不断改进，以优化所有原材料的消耗水平，尽可能地回收利用。采用 3R 理念节约用水，降低消耗，多次回用，处理后的废水回用。在能源方面，通过提高制造工艺的效率、提高锅炉和涡轮机的效率、减少系统损失和回收余热，降低每吨纤维的能源消耗。

## 2 Objective 目标

The objective of this assessment is to verify the ecological benefits of production of LivaEco™ of Birla Jingwei Fibres Company Limited (BJFCL)

本次评价的目的是验证 Birla Jingwei Fibres Company Limited (BJFCL) 生产 LivaEco™ 的生态效益。

## 3 Our Approach & Methodology 途徑及方法

To meet the objective, we identified and validated both short and long term projects carried out towards bringing radical change in the environmental impact from the facility. In addition, parameters for benchmarking the facility as per EU BAT were also

evaluated as an opportunity to identify and validate the impact of near and long projects carried out by the facility .

- The site has two Viscose manufacturing lines. The lines were commissioned in 2006 and 2010 and are fully in operation and stable production since then.
- The roadmap for commercialization of Liva Eco had two stages, first stage was to achieve the targeted level of performance till Mar 2019 and in second stage to stabilize the production at targeted level in period April, 2019 to June 2019.

Sustainable Textile Solutions (STS), a stabilized advisory firm with the team of experts in the regenerated Fibre production and energy conservation: Following experience and expertise STS brings to make the program effective;

- Expertise in global experience related to man-made Fibre technology, energy conservations and Waste water technologies.
- Technical support in planning and implementation of identified improvements.
- Support in building the business and financial case.
- Verification and traceability confirmation as per standards such as Canopy, FSC®, Energy intensity, emission based on MIS verification link with external agencies report.

为了实现这一目标，我们确定并验证了为彻底改变设施对环境的影响而开展的短期和长期项目。此外，还评估了根据欧盟 BAT 对设施进行基准测试的参数，以此来确定和验证设施实施的近距离和长期项目的影响。

- 工厂有两条粘胶生产线。这两条生产线分别于 2006 年和 2010 年投入使用，并从那时起全面投入运行和稳定生产。
- LivaEco™ 商业化路线图分为两个阶段，第一阶段是在 2019 年 3 月之前达到目标绩效水平，第二阶段是在 2019 年 4 月至 2019 年 6 月期间将生产稳定在目标水平。

Sustainable Textile Solutions (STS), 是一家咨询顾问公司，由再生纤维生产和节能方面的专家组成：STS 带来了以下经验和专业知识，以使项目有效：

- 在人造纤维技术、节能和废水技术方面具有全球经验方面的专门知识。
- 在规划和实施确定的改进方面提供技术支持。
- 支持建立业务和财务案例。
- 根据标准进行验证和可追溯性确认，如 Canopy, FSC®，能源使用、排放基于外部机构报告的可追溯性验证链连接的。

#### **4 Indicated KPI Tracked 跟踪指定的关键绩效指标**

The program will track the key performance indicators in order to measure the improvement realized from the implementation of resource efficiency measures. These are mapped on year on year basis and shift from good manufacturing practices to best practices.

Efficiency of Closed Loop Production System including:

- Fresh Water Consumption (m<sup>3</sup>/TF)
- Energy Intensity and waste heat utilization (GJ/TF)
- Chemicals recovery- importantly sulfur, Sodium Sulfate

Waste water Treatment Efficiency

- Treated wastewater discharge (m<sup>3</sup>/TF)
- COD Load (Kg/TF)
- Zn Load (Kg/TF)

该方案将跟踪关键绩效指标，以衡量实施资源效率措施所实现的改进。这些都是逐年绘制的，并从良好的生产实践转变为最佳实践。

闭环生产系统的效率包括:

- 淡水消耗量 (m<sup>3</sup>/TF)
- 能源强度和余热利用 (GJ/TF)
- 化学品回收-重要的是硫磺、硫酸钠

废水处理效率

- 处理废水排放量 (m<sup>3</sup>/TF)
- COD 负荷 (Kg/TF)
- 锌负荷 (Kg/TF)

## 5 Time Frame considered 考虑的生产时段

- LivaEco™ Production Frame

**Liva Eco Data used for Comparison, Apr 2019 to June 2019**  
**Number of Spinning lines – Two**  
**Commercial Production of Liva Eco Sep 2019.**  
**Sulfur Balance – Aug 2019**

- Total Production Frame considered  
**FY 2015 (April, 2014 to March 2015)**  
**FY 2016 (April, 2015 to March 2016)**  
**FY 2017 (April, 2016 to March, 2017)**  
**FY 2018 (April, 2017 to March, 2018)**  
**FY 2019 (April, 2018 to March, 2019)**

## **FY 2020 (April 2019 to Jun 2019, sulfur balance Aug 2019)**

- LivaEco™ 生产时段

用于比较的 Liva Eco 生态数据，2019 年 4 月至 2019 年 6 月

纺纱生产线数量 — 2 条

Liva Eco 商业生产 — 2019 年 9 月。

硫平衡 — 2019 年 8 月

- 考虑的整体生产时段
  - 2015 年度 ( 2014 年 4 月至 2015 年 3 月 )
  - 2016 年度 ( 2015 年 4 月至 2016 年 3 月 )
  - 2017 年度 ( 2016 年 4 月至 2017 年 3 月 )
  - 2018 年度 ( 2017 年 4 月至 2018 年 3 月 )
  - 2019 年度 ( 2018 年 4 月至 2019 年 3 月 )
  - 2020 年度 ( 2019 年 4 月至 2019 年 6 月 , 硫平衡 2019 年 8 月 )

## **6 Birla Jingwei Fibres Company Limited (BJFCL), China** **Birla Jingwei Fibres 有限公司(BJFCL), 中国**

Birla Cellulose is a pioneer in Viscose Staple Fiber, made from completely renewable natural sources, a fully biodegradable cellulosic fibre with superior characteristics. Viscose is a highly versatile and can be easily blended, used in apparels, home textiles, dress material, knitted wear and non-woven applications. Birla Cellulose offers the entire range of cellulose fibre under the umbrella brand 'Birla Cellulose', including Standard Viscose fiber, Modal, Lyocell, dope dyed fibre and now Woven fiber. The fibre can be used in its original form or can be blended with all natural and synthetic fibres for enhanced comfort, feel and luster. Production of Viscose Staple Fibre (VSF) was started in 1954 at Nagda, in Madhya Pradesh.

Birla Jingwei Fibres Company Limited (BJFCL) is Aditya Birla Group's viscose staple fibre (VSF) manufacturing company located in the Hubei Province of central China. It was established in 2006 as a joint venture company between the Aditya Birla Group and the Fujian Jingwei Group. In 2008, Aditya Birla Group acquired ownership of the company. Current annual capacity of the facility is 85,000 TPA

This plant has currently producing specialty fibres i.e. LivaEco™ ,(Spun dye and grey Viscose) and standard grades of Spun dye and Grey viscose. Viscose LivaEco™ natural based fabric gives the garments a unique combination of fluidity and luxurious softness. In addition to draping you effortlessly, LivaEco™ is Pro-

Planet and helps save water, increases forest cover and reduces CO2 emission, so these regenerated fibres help and preserve the environment and reduce impacts. The raw material used is FSC certified and full traceability is provided across value chain.

Birla Cellulose 是粘胶短纤维的先驱，由完全可再生的天然资源制成，是一种具有优越特性的完全可生物降解的纤维素纤维。粘胶纤维是一种用途广泛且易于混合的纤维，用于服装、家用纺织品、服装材料、针织服装和无纺布应用。Birla Cellulose 提供品牌“Birla Cellulose”下的所有纤维素纤维，包括标准粘胶纤维、Modal 纤维、Lyocell 纤维、原液染色纤维和无纺纤维。纤维可以独自使用，也可以与所有天然和合成纤维混合使用，以增强舒适性、手感和光泽。粘胶短纤维 ( VSF ) 的生产始于 1954 年在印度中央邦的纳格达。

Birla Jingwei Fibres Company Limited (BJFCL)是 Aditya Birla 集团旗下的粘胶短纤维 ( VSF ) 制造公司，位于中国中部的湖北省。该公司成立于 2006 年，是 Aditya Birla 集团和福建 Jingwei 集团的合资公司。2008 年，Aditya Birla Group 收购了该公司的所有权。工厂目前的年产能为 85,000 吨/年

这家工厂目前生产特种纤维，即 LivaEco™ ( 纺纱染色和原白粘胶纤维 ) 和标准等级的纺纱染色和原白粘胶纤维。粘胶 LivaEco™ 天然面料赋予服装独特的可流动性和奢华的柔软性。除了优良的裁剪性和穿着性外，LivaEco™ 还有助于节约用水、增加森林覆盖率和减少二氧化碳排放，因此这再生纤维有助于保护环境和减少影响。所使用的原材料经过 FSC 认证，在整个价值链中提供完整的可追溯性。

Table 1 - Comparison between LivaEco™ (Apr – Jun 2019) & Regular VSF FY 2015  
表 1: LivaEco™ ( 2019 年 4 月至 6 月 ) 与 2015 年度常规 VSF 的比较

S. No.	Sustainability Indicators 可持续性绩效指标	Regular VSF Year 2015 常规 VSF 2015 年	LivaEco™	LivaEco™ Elevated by LivaEco™ 的提升
1	Sustainable Forestry 可持续林业 Certification for pulp used* 木浆使用证明*	Yes (SFI, FSC® combination)	FSC®	FSC®
2	FSC® - Chain of Custody Credit Availability 产销监管链	Partly	Yes	Yes
3	Canopy Green Shirt	Yes	Yes	Yes
4	Energy Intensity 能量强度	100	81.4	18.6%
5	GHG Emission** 温室气体排放**	100	81.4	18.6%
6	Sulphur Emission*** 硫排放***	100	17	87%
7	Sodium Sulphate Recovery 硫酸钠回收	100	101.1	1.1%
8	Fresh Water Consumption 淡水消耗量	100	64.1	35.9%
9	Treated Waste Water Discharge 处理后废水排放	100	70.4	29.6%



10	Zn in Discharged water meets EU BAT Norm 排放水中锌符合欧盟BAT标准	Yes	Yes	Yes
11	COD in Discharged water 废水COD	100	74.1	25.9%
	COD in Discharged water meets EU BAT Norms 废水中COD符合欧盟BAT标准	No	Yes	Yes

Note: All the Unit of Measurement is indexed by setting values for Regular Viscose as 100 (base year 2015).

\* FSC System for Liva Eco

FSC certified pulp is used in making Liva Eco.

FSC credit for fiber will be available for entire quantity product supplied as Liva Eco

FSC label can be used on the product. FSC Mix label

\*\*Based on Energy intensity

\*\*\* Sulfur Emission - Data after commissioning of CAP system in Aug 2019

注：所有计量单位均以普通粘胶设定值100（基准年2015年度）为基准。

应用于的系统

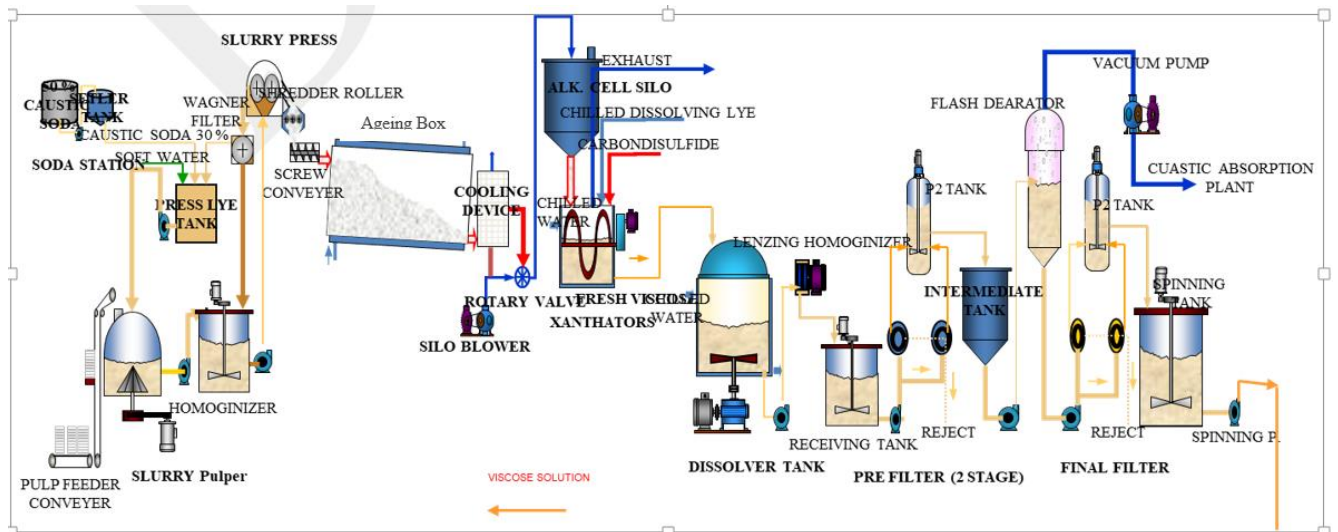
FSC认证的纸浆用于生产Liva Eco

作为Liva Eco提供的所有数量的产品都可获得纤维的FSC信用

FSC标签可用于产品上。FSC混合标签

\*\*基于能量强度

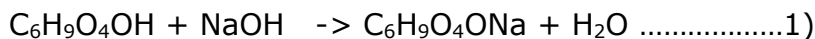
\*\*\*硫排放-2019年8月CAP系统调试后数据



## 7 Viscose Staple Fibre manufacturing 粘胶短纤的生产

The raw material in this unit is pulp and process starts as follows

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

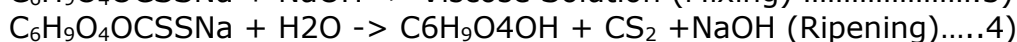


**Shredding** – Pressed Slurry add on for Shredding followed by Ageing  
 Ageing – In this process shredded alkali cellulose is matured in ageing box. In this process the DP (Degree of polymerization) of Fibres reduces required levels. Afterward it passes through Xanthation step.

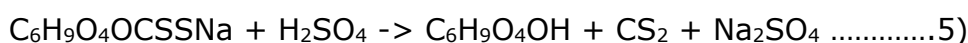
**Xanthation & Dissolution** – The Aged alkali cellulose is made to react with Carbon disulphide under vacuum in xanthator, which is later dissolved in caustic soda. The xanthator is then exhausted and xanthate slurry is dropped into dissolver for thorough dissolving.



**Ripening filtration & De-Aeration** - This system consists of blenders, receivers, filtration and de- aerator. The indigenous Grasim Continuous filter (GCF) are installed in all stages of filtration.



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



原料是木浆，工艺流程如下：

木浆的浸渍 -- 用自动加料系统向打浆机中添加烧碱，并同时丝光化



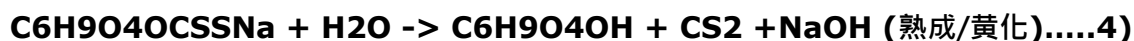
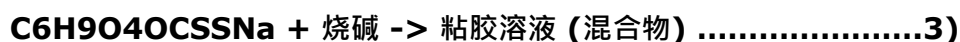
粉碎 – 压榨后粉碎，然后老成

老成 – 粉碎的碱性纤维素在老化箱中成熟，在此过程中纤维的聚合度降低了所需的水平，然后经过黄原化过程。

黄原化和溶解 – 真空条件下，老化的纤维素纤维在磺化设备中与二硫化碳反应，其后溶于烧碱中。然后从反应器中将黄原酸浆抽出，放入溶解器中充分溶解。



成熟过滤和脱气 – 这个系统由搅拌器、接收器、过滤和脱气装置组成。在过滤的所有阶段都装置了国产的 **Grasim** 连续过滤器 ( **GCF** ) 。



纺丝 – 湿法纺丝是在含有硫酸、锌和硫酸钠的纺丝槽中，将经过滤和脱气的粘胶液混凝而成。该设备能生产 **1.2** 到 **0.6** 旦的粘胶丝。



## 8 Data Verification of Key Environmental Performance Indicators 关键环境绩效指标数据验证

### 8.1.1 Energy Intensity 能源强度 (GJ/TF)

Energy consumption/Intensity 能耗/单位 (GJ/TF):

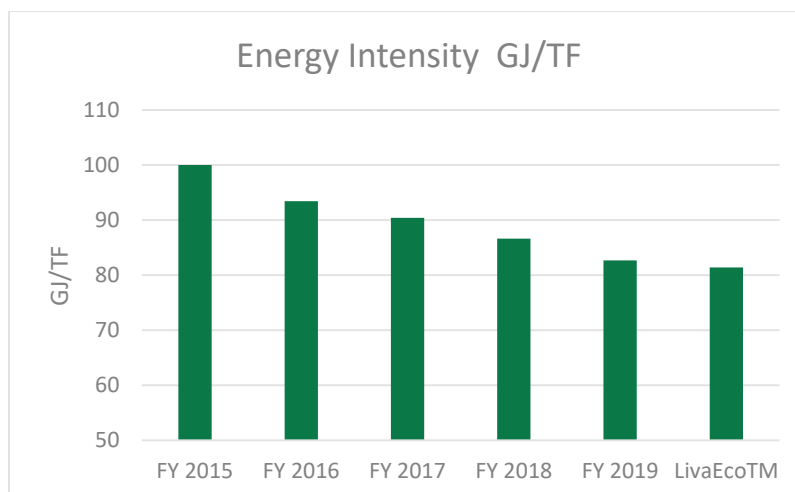


Fig 1: Energy intensity 图 1: 能源强度(GJ/TF)

### 8.1.2 Fresh Water consumption 淡水消耗量

Fresh Water consumption 淡水消耗量:

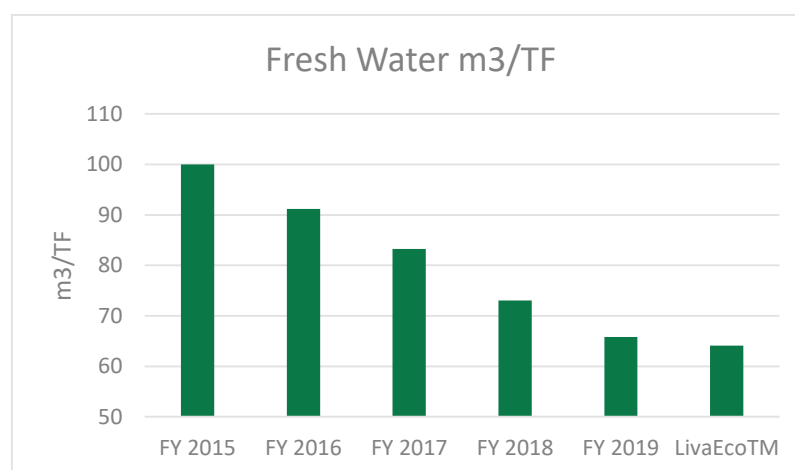


Fig 2: Fresh Water Consumption 图 2: 淡水消耗量(m3/TF)

### 8.1.3 Treated Wastewater 污水处理量

**Waste Water Treatment Load (Normalized) 污水处理量 (标准化) :**

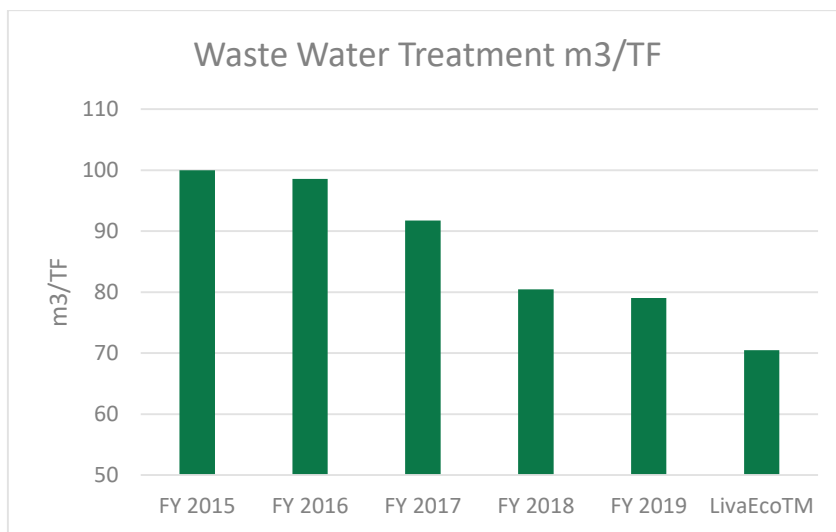


Fig 3: Treated Wastewater load 图 3 : 污水处理量(m3/TF)

### 8.1.4 COD Load COD 负荷

**COD Load COD 负荷(kg/TF)**

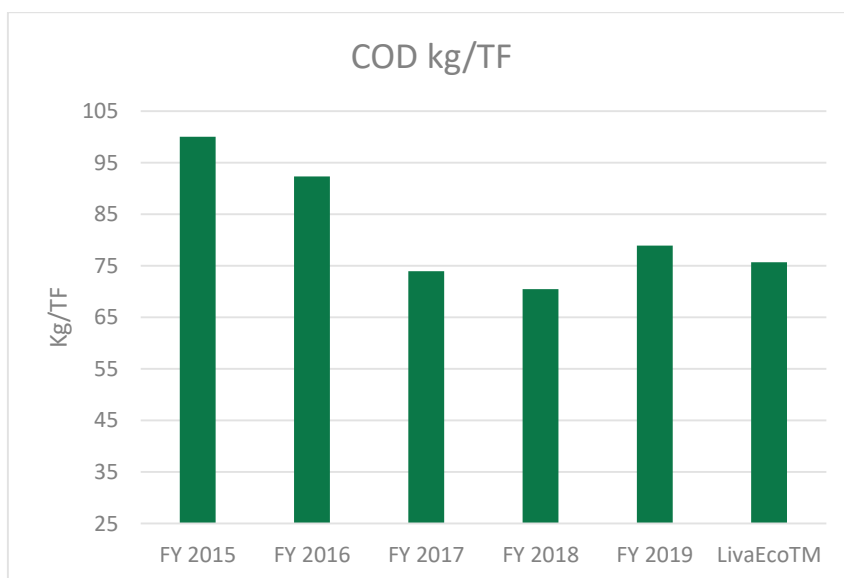


Fig 4: COD load (kg/TF). The COD after 2017 is within the normal range of variation.

图 4 : COD 负荷。 2017 年后的 COD 在正常范围变化

### 8.1.5 Performance of the Closed Loop Production System

#### 闭环生产系统的性能表现

##### **The Consumption ratios and Emission performance of the plant.**

The consumption ratio of the key raw materials were verified using the historical data and the evaluation period of Liva Eco (April to June 2019). The result of the evaluation is tabulated in the table 2. For the verification of the data, the plant records from log books and the MIS (management information system) were checked and verified. The results for each of the parameters were checked and results are tabulated in Table 2.

##### The CS<sub>2</sub> recovery system

BJFCL has recently commissioned the EU BAT reference technologies for recovery of CS<sub>2</sub> to strengthen the Closed Loop production system. The system for recovery of CS<sub>2</sub>, CAP (CS<sub>2</sub> adsorption on Activated Carbon columns) has been fully commissioned and made operational in Aug 2019. A mass balance of the sulfur was done to check the effectiveness of the new closed loop technology in terms of controlling the sulfur emission to the air. Below are the conclusions from this exercise:

- The CS<sub>2</sub> consumption has reduced by 68% from the baseline of year 2015.
- The CS<sub>2</sub> consumption meets the EU BAT consumption norms.
- The Sulfur emission to air based on mass balance is below the EU Eco Label norm of 30 Kg/TF.

#### 工厂的消耗率和排放表现

利用 Liva Eco 的历史数据和评估期 ( 2019 年 4 月至 6 月 ) , 对关键原材料的消耗率进行了验证。评估结果见表 2。为了验证数据, 对记录簿和管理信息系统 ( MIS ) 中的工厂记录进行了检查和验证。检查了每个参数的结果, 结果见表 2。

**CS<sub>2</sub> 回收系统**最近参考欧盟 BAT 技术回收 CS<sub>2</sub>, 以强化闭环生产系统。CS<sub>2</sub>、CAP ( 活性炭柱吸附 CS<sub>2</sub> ) 回收系统已全面投产, 并于 2019 年 8 月投入运行。通过硫的质量平衡, 验证了新型闭环技术在控制大气硫排放方面的有效性。以下是这项工作的结论:

- CS<sub>2</sub> 消耗量比 2015 年的基线下降了 68%。
- CS<sub>2</sub> 消耗符合欧盟 BAT 消耗标准。
- 基于质量平衡的大气硫排放量低于欧盟生态标签标准 30kg/TF。

**Table 2 EU BAT norms Viscose vis-à-vis LivaEco™ at glance as follows:**

表 2: EU BAT 标准粘胶纤维与 Liva Eco 的对比一览表如下:

Sr. No.	Particulars / Parameters 细节/参数	Unit 单位	EU BAT	LivaEco™
<b>A</b>	<b>Consumptions per TF 用量/TF</b>			
1	Energy 能源	GJ	20-30	✓
2	Total Water 总用水量	m <sup>3</sup>	224-330	✓
3	Pulp 木浆	t	1.035-1.065	✓
4	CS <sub>2</sub>	kg	80-100	✓
5	H <sub>2</sub> SO <sub>4</sub>	t	0.6-1.0	✓
6	NaOH	t	0.4-0.6	✓
7	Zn	kg	2-10	✓
8	Spin finish 纺纱后整	kg	3-5	✓
9	NaOCl	kg	0-50	✓
<b>B</b>	<b>Air Emissions 气体排放</b>			
1	Sulphur to air (VSF Process) (EU ECO Label Norms)Note 1 硫排放 (VSF 工艺) (欧盟生态 标签规范) 注 1	Kg/TF	30	✓
<b>C</b>	<b>Treated Wastewater Discharge 处理后废水排放</b>			
1	SO <sub>4</sub> <sup>2-</sup>	kg/TF	200-300	✓
2	COD	kg/TF	3-5	✓
3	Zn	g/TF	10-50	✓

Legend: ✓ - LivaEco™ performance well within EU BAT norms of Viscose

Note: 1 During the visit, the inspection of Sulfur emission control system was done. The site has installed the system to recover the H<sub>2</sub>S and CS<sub>2</sub> from exhaust gases and has achieved the Emission level of less than 30 Kg/TF.

图例: ✓-LivaEco™ 性能表现符合欧盟 BAT 粘胶标准

注 1: 参观期间对硫磺排放控制系统进行了检查。现场安装了从废气中回收 H<sub>2</sub>S 和 CS<sub>2</sub> 的系统, 达到了小于 30kg/TF 的排放水平。

## 9. Observations and KPI Data Analysis 观察结果和关键绩效指标数据分析

Production	Facility has improved the Closed Loop production year on year basis by improving its efficiency, recovery systems and productivity. LivaEco™ production monitoring started after April 2019 after optimizing all production systems and environmental impacts and generating full traceability from forest to Fibre. The CAP system was
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	<p>installed in period 2018-19 and commissioned in started in beginning of August 2019.</p>
<p>Traceability</p>	<p>The site has FSC® (Forest Stewardship Council®) Chain of Custody (CoC) certification. 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 Liva Eco and 100% credit of FSC can be passed on the customers as per their request.</p> <p>The chemical consumption was found to be registered with its lot number confirmed. This makes the current whole production including LivaEco™ completely traceable.</p> <p>Higg FEM 3.0 has been implemented at site and the latest assessment was done in Apr-May 2019. The site evaluation of Higg FEM 3.0 has been verified by the Third party, Thinkstep Germany and has achieved a high score of 91% reflecting the high level of maturity in the benchmark best practices specified by Sustainable Apparel Coalition (SAC).</p>
<p>Environmental Impacts Indicators</p>	<p>Facility has reduced its Energy intensity year on year (Fig-1) from initial years of regular viscose production. The improvement in energy consumption was found to be due to process improvements and energy savings in moving to closed loop system, viscose maturing system, recirculation system, spin bath recovery system, fiber dryers etc. The waste energy has been recovered at several places as identified by the internal maintenance team to achieve short and long energy conservation targets. With the reduction of energy intensity, the GHG emission has also reduced resulting in lower impact on environment. There is improvement in boiler and turbine efficiencies.</p> <p>Similar trends also observed in the fresh water consumption in the facility from year on year basis (Fig 2). The less intake of fresh water is due to modification of process by using 3R principles such as lower consumption, recycling and reuse of water as well as improvisation of waste water treatment technologies.</p> <p>Due to reduction in water usage the waste water generation has also reduced from year to year basis which directly impacts into COD reduction (Fig 3 and 4). It was also observed that in last few months there are significant improvement in COD values.</p> <p>The COD and Zn discharge loads of BJFCL were checked and found to be within the EU BAT reference limits.</p>



By Products	<p>As indicated in spinning bath chemical reaction, process generates sodium sulphate (Na<sub>2</sub>SO<sub>4</sub>) (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.</p>
EU BAT	<p>LivaEco™ production follows the closed loop manufacturing process. Best available technologies (BAT) are implemented to recover and recycle all the material and energy resources.</p> <p>The site meets all the consumption norms of EU BAT as well as all water discharge norms EU BAT, as indicated in the Table no 2. For Sulfur emission to air, it follows the EU Ecolabel norm of 30 Kg/TF.</p>
生产	<p>工厂通过提高效率、回收系统和生产率，逐年改善了闭环生产。LivaEco™ 生产监控始于 2019 年 4 月，此前优化了所有生产系统和环境影响，实现了从森林到纤维的全面可追溯性。CAP 系统于 2018-19 年安装，并于 2019 年 8 月初开始试运行。</p>
可追溯性	<p>工厂有 FSC® (Forest Stewardship Council®) 监管链 (COC) 认证。FSC® 认证确保材料和产品在加工的每个阶段都经过检查，产品中的木材完全来自 FSC 认证及管理良好的森林。验证从木浆到纤维的生产记录以符合生产的可追溯性。Liva Eco 采用 FSC 认证木材，根据客户要求，可将 FSC 100% 的信用传递给客户。化学品的消耗已登记，批号已确认。这使得目前包括 LivaEco™ 在内的整个生产完全可追溯。</p> <p>Higg FEM 3.0 已在现场实施，最新评估于 2019 年 4-5 月完成。Higg FEM 3.0 的现场评估已得到第三方 Thinkstep Germany 的验证，并获得 91% 分，反映出可持续服装联盟 (SAC) 规定的基准最佳实践的高度成熟。</p>
环境影响指标	<p>设施已从常规粘胶生产的最初几年逐年降低其能源强度 (图 1)。能源消耗的改善是由于工艺改进和迈向闭环系统、粘胶优化系统、再循环系统、纺纱浴回收系统、纤维烘干机等能源节约所致。内部维护团队已在多个地方回收了废能源，实现短期和长期节能目标。随着能源强度的降低，温室气体排放也随之减少，对环境的影响也随之降低。锅炉和涡轮机的效率有所提高。</p> <p>设施的淡水消耗量同比也出现了类似的趋势 (图 2)。由于采用 3R 原则 (如降低消耗、水的循环利用和再利用) 以及废水处理技术的改进，淡水的摄入量减少。</p>

	<p>由于用水减少，废水产生量也逐年减少，这直接影响到 COD 的减少（图 3 和图 4）。在过去的几个月里，COD 值也有了显著的改善。</p> <p>对 BJFCL 的 COD 和锌排放负荷进行了检测，发现其在 EU BAT 参考限值内。</p>
副产物	<p>工艺副产物如纺丝浴化学反应所示，以硫酸钠盐 <math>\text{Na}_2\text{SO}_4</math>（反应-5）为副产物，回收后可用于其它工业。根据化学计量反应步骤优化盐的回收率，以确保降低废水负荷是非常重要的。随着产量的增加，盐量增加，盐回收率一直保持在一个稳定的水平。</p>
欧盟 BAT	<p>LivaEco™ 生产遵循欧盟 BAT 闭环生产流程。采用最佳可用技术（BAT）回收和循环利用所有材料和能源资源。</p> <p>如表 2 所示，现场符合欧盟 BAT 的所有消耗标准以及欧盟 BAT 的所有排水标准。对于排放到空气中的硫，它遵循欧盟生态标签标准 30kg/TF。</p>

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