



CircleToZero

Towards Zero Emissions and Zero Waste at Pulp and Paper Mills



CircleToZero™ is a global ANDRITZ initiative with the goal of achieving zero emissions and zero waste at the same time as creating financial growth for customers. For pulp and paper producers, this means eliminating unused industry side streams, turning them into new value-added products and achieving zero emissions and zero waste production.

ANDRITZ is inviting customers, partners, and the research community to join a shared journey towards a more sustainable society and to meet the industry growth demands set by the transition into a fossil-free circular bioeconomy.

Pulp and paper production creates multiple gaseous, solid, and liquid side streams. Their elimination, reduction, purification, and conversion are a continuous challenge, requiring new technologies and solutions with clear environmental and financial payback.

The journey towards this has already started. ANDRITZ is currently helping its customers to use less fresh chemicals and water as well as reducing industrial emissions and waste. It is doing this by increasing resource and operational efficiency and turning traditionally unused side streams into new commercial products. In addition, these actions dramatically reduce pollution to air, land, and water as well as reduce traffic and logistics around the mill.

WHAT IS CircleToZero?

The pulp and paper industries play a key role in the transition and transformation towards a fossil-fuel free circular bioeconomy. By developing circular operations to eliminate unused side streams, and creating new value-added bio-based products, it can be the global leader in zero emissions and zero waste industrial processes.

CircleToZero brings together the continuous development and improvement of existing ANDRITZ technology solutions to achieve this leadership position with clear environmental and financial benefits.

CircleToZero is a collaboration-driven process, where we share innovations, develop new solutions, and contribute to the positive financial returns and environmental impact of the whole industry – together with our customers, research institutes, and other partners.

WHY CircleToZero?

The pulp and paper industries are growing. Growing while achieving zero emissions and zero waste together with higher overall resource efficiency is the main driver for sustainability of the industry. Regulations, capital and customer demand all

require solutions to resource scarcity, mitigating climate change, and the need to create more added value while using less natural resources.

Pulp and paper production creates multiple gaseous, solid, and liquid side streams. These side streams include, for instance:

Gaseous side streams: Nitrogen oxides, sulfur dioxides, odorous gases, and carbon dioxide

Solid side streams: Dregs and grits, sludge, ash and gasifier bottom ash, reject fibers, and lime mud

Liquid side streams: Filtrates, raw methanol, condensates, sulfate rich streams, and crude sulfate turpentine

Currently, the ANDRITZ A-Recovery+ concept unleashes the economic potential of the many traditionally unused side streams. These include purifying raw methanol into commercial quality bio-methanol, the on-site production of sulfuric acid, and recovery of kraft lignin.

CircleToZero OPPORTUNITIES

CircleToZero opportunities for developing both circular operations and new products in the pulp and paper industry are:

1. Circular operations. CircleToZero is achieved by applying higher efficiency and closed loops throughout the mill-wide production. Future opportunities include reducing fresh water usage by increasing the recyclability of used water – towards a Zero Liquid Discharge mill, process wide capturing of biogenic CO₂, and further utilization of captured carbon dioxide in the creation of new products.

2. Value added products. There is a significant opportunity for CircleToZero in replacing fossil-based products with new wood-based products and materials by utilizing the existing side streams in a better and more efficient manner. The replaceable materials include plastics, composites, textiles, industrial bio-chemicals, and biofuels. Also, ANDRITZ fiber

processing technologies make it possible to produce new value-added bioproducts from wood fiber itself, including dissolving pulp and micro crystalline cellulose.

Looking at the current side streams, ANDRITZ has identified several CircleToZero opportunities for elimination, reduction, and further use in and outside the mill.

GASEOUS SIDE STREAMS	CircleToZero OPPORTUNITIES
Nitrogen oxides	• NOx reduction technologies
Sulfur dioxide	• SO ₂ removal technologies
Odorous gases	• Odorous gas handling and treatment
Carbon dioxide	• BioCO ₂ utilization with hydrogen to produce biomethanol
SOLID SIDE STREAMS	CircleToZero OPPORTUNITIES
Dregs and grits	• Source of alkali • Conversion into fertilizers by removing hazardous components
Sludge	• Conversion into pellets • New product development
Ash and gasifier bottom ash	• Purification and reuse outside the mill • Gasifier bottom ash as new raw material
Lime mud	• Purification and reuse • Source of alkali
LIQUID SIDE STREAMS	CircleToZero OPPORTUNITIES
Filtrates	• New strategies to handle filtrates • Recirculation of purified filtrates • Reduced fresh water usage that is aiming towards the Zero liquid discharge mill
Raw methanol	• Purification and reuse in and outside the mill • New revenue generation
Condensates	• Reuse of condensates • Fresh water usage reduction
Sulfate rich streams	• Extraction of sulfate to reduce the fresh water usage
Crude sulfate turpentine	• Purification and reuse outside the mill • New revenue generation

FROM AMBITION TO SUSTAINABLE REALITY

ANDRITZ recognizes that creating economic and environmental value is not without its challenges. Alongside customers and partners, CircleToZero aims to change this.

Turning CircleToZero into reality will be fueled by achieving immediate bottom-line savings, identification of new business and investment opportunities, and the ability to comply with tightening regulations. CircleToZero can solve the age-old problem where an

investment set out purely to reduce emissions is rarely financially feasible.

ANDRITZ has strong customer support and partnerships to turn CircleToZero solutions into a reality. Collaboration will be crucial to grasp the wealth of opportunities at stake and develop innovative business models together. Building on technology expertise, ANDRITZ will provide its customers with gap analyses and recommendations for existing mills to adapt and is also able to demonstrate a payback time close to zero for new projects, if properly planned ahead with the CircleToZero approach.

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WALKING THE TALK: CircleToZero IN ACTION WITH ANDRITZ A-RECOVERY+

With existing and developing technologies, CircleToZero can bring opportunities for new and lucrative bio-based products by converting and utilizing side streams. In this issue of SPECTRUM, there are two prime examples of the CircleToZero initiative being put into action using the A-Recovery+ concept from ANDRITZ:

Södra Cell recently started up the world's first biomethanol plant at its Mösterås pulp mill in southern Sweden. Using the A-Recovery+ concept from ANDRITZ, the mill extracts methanol from the pulp process, and now has the capacity to produce 6.3 million liters of commercial quality biomethanol. The biomethanol is then sold as a substitute for fossil-based methanol to be used in the transport sector.

Klabin recently ordered a sulfuric acid plant for its Ortigueira mill in southern Brazil. Again using the ANDRITZ A-Recovery+ concept, the mill will use sulfur-containing gases – which are usually burned in the boilers or lime kiln – to produce its own sulfuric acid at the same time as controlling the sodium and sulfur balance of the mill. The result will be major savings on chemicals including sulfuric acid, but also drastically reducing consumption of sodium make-up chemicals.

The concept of A-Recovery+ is to look at all the chemical cycles in a mill as a whole and examine where further use, possible recycling, or the refining of different side streams can take place. Ultimately, the goal is to further use the side streams to create more value by producing bio-based products to either be used at the mill or sold on the commercial market.

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