SOSTENIBILIDAD EN CADA FIBRA

Aprovechamiento energético de residuos en la industria del papel

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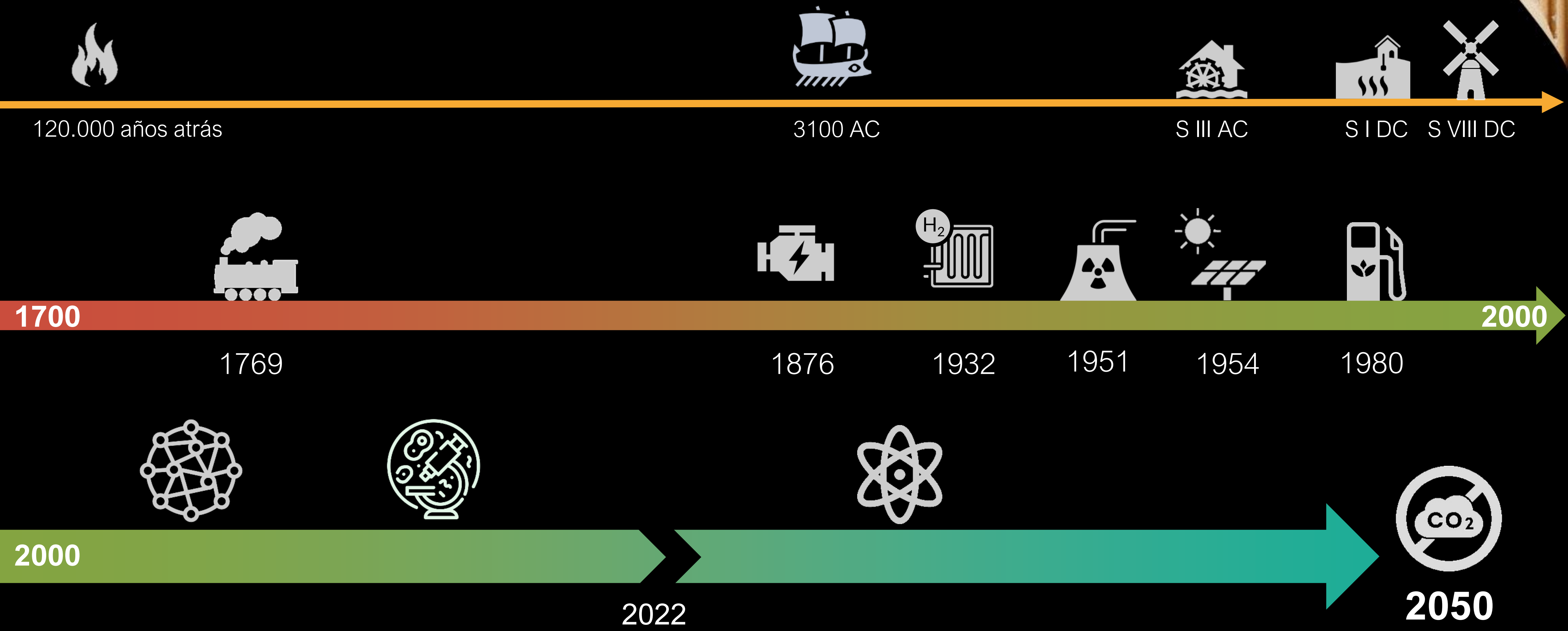
Septiembre 1 de 2022



120.000 años atrás
3100 AC
S III AC
S I DC
S VIII DC
1700
2000
1769
1876
H_2
1932
1951
1954
1980
2000
2022
CO_2
2050

Agenda

- Acerca de Smurfit Kappa
- Aprovechamiento de residuos
  - Etapa 1: Fase investigativa
  - Etapa 2: Pruebas industriales
  - Etapa 3: Implementación
- Proyecciones


ACERCA DE SK

Alcance geográfico

Colaboradores

Continentes

Países

Operaciones

Clientes

Nuestras operaciones en Colombia

Forestal

68.000

hectáreas de plantaciones forestales

Reciclaje

7,4 Millones

toneladas de papel recuperado al año

Papel

8,3 Millones

toneladas de papel y cartón al año

Empaques

12,5 Mil Millones

m^2 producidos al año

La verdadera sostenibilidad es de extremo a extremo

SELLO AMBIENTAL
COLOMBIANO

Nuestro modelo de negocio circular

75%

de nuestra materia prima son fibras recicladas.

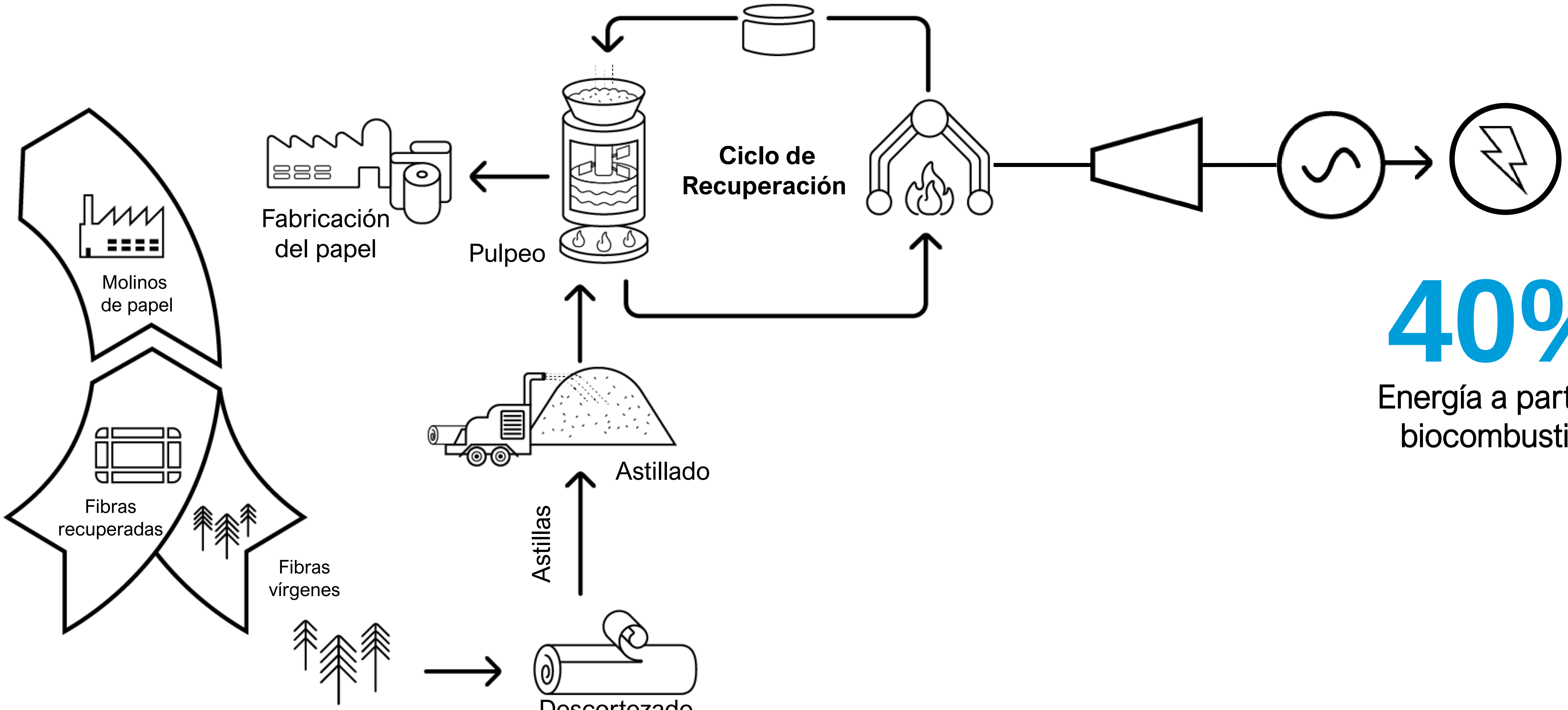
Utilizamos materiales renovables, reciclables, y biodegradables para crear productos nuevos.

40%

de la energía es autogenerada con biocombustibles provenientes de subproductos de nuestro proceso en Cali.


APROVECHAMIENTO
DE RESIDUOS

¿Cómo producimos bioenergía en SK?



40%

Energía a partir de biocombustible

Otros subproductos aprovechables

Planta de tratamiento de madera

Planta de tratamiento de aguas residuales

Caldera de carbón

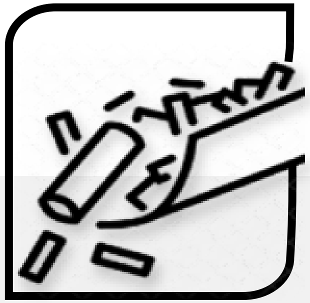
Pin Chips

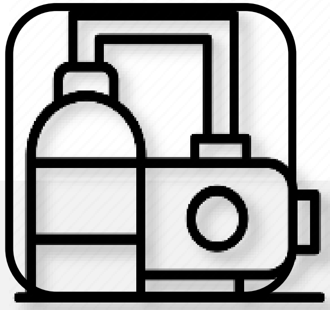
Aserrín

Lodos de PTAR

Cenizas con altos inquemados

Ruta de navegación





2014

Etapa 1

2019

Etapa 2

2022

Etapa 3

2024

Fase investigativa

Inicio de investigación, caracterización de fuentes, y ensayos.

Pruebas industriales

Peletización y alimentación a caldera de carbón.

Implementación

Co-combustión en caldera existente.

1

FASE INVESTIGATIVA

Sinergia entre residuos

Estudio con el Grupo de investigación TAYEA de la UNAL Medellín

Dos residuos sólidos muy diferentes, ambos con alto contenido de inorgánicos (bajo valor económico):

Lodos de PTAR

Quema fácilmente
33% material volátil

Quema por corto tiempo
0,4% carbón fijo

+

Cenizas de caldera de carbón con alto contenido de inquemados

Necesita temperatura muy alta para quemar
9% material volátil

Quema por más tiempo
58% carbón fijo

No pueden aprovecharse energéticamente de forma separada

Pellets

Peletizándolos juntos se aumenta en más de 80% su densidad energética.

Estudios con la UNAL

2014 – 2018

- Pellets con mezcla de los tres residuos principales:
  - 66% lodos húmedos (@50%)
  - 33% cenizas
  - 1% aserrín

- HHV: 9 – 14 MJ/kg
  - Carbón HHV: 20 – 30 MJ/kg

Emisiones teóricas

Restricciones legales en: SO_2, NOx, furanos y dioxinas.

Del estudio con la universidad se concluyó:

- No se identificaron furanos ni dioxinas durante la combustión.
- Las emisiones de SO_2 y NOx estuvieron por debajo de los límites legales.
- A pesar de que las cenizas contenían sulfuros, este no se volatiliza, quedándose en las cenizas finales.

Publicaciones

Applied Thermal Engineering

Applied Thermal Engineering 124 (2017) 191–201

Contents lists available at ScienceDirect

Applied Thermal Engineering

journal homepage: www.elsevier.com/locate/apthermeng

Research Paper

Energy evaluation of pelletized mixtures of IWTP sludge and coal-fired boiler ashes by co-combustion: Identification of synergistic effects

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H I G H L I G H T S

- Mixture solid waste witch good characteristics for co-combustion was develop.
- The pellets co-combustion at high temperatures is governed for rate of reaction.
- Developed techniques represent a synergic opportunity to assess industrial residues.

A R T I C L E I N F O

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Received 10 April 2017
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Accepted 3 June 2017

Keywords:
Co-pelletization
IWTP primary sludge
Coal-fired boiler ashes
Pellets quality
Volumetric energy density
Synergy in residues

A B S T R A C T

In order to reduce the amount of solid industrial residues of a factory and to harness its thermal potential, a co-combustion technique has been developed. This technique aims to co-pelletize Industrial Wastewater Treatment Plant (IWTP) primary sludge, and non-reactive fly ashes with high loss of ignition coming from an industrial coal chain-grate stoker boiler. This technique represents a synergistic opportunity to capitalize the heating power within each residue, in two main ways: first, pelletization on its own has proven benefits on energy densification, in terms of volume reduction for transport and storage; second, the reactivity of fly ashes increase with the volatile matter contribution of the primary sludge, improving the thermal properties of the mixture and its performance under combustion. The later was demonstrated by thermogravimetric analysis of the different mixture ratios evaluated. Furthermore, it was demonstrated that the char co-combustion of the pellets is dominated by the reaction rate, while the previous process of devolatilization is dominated by mass and heat transfer phenomena simultaneously with the kinetic reaction.

1. Introduction

2017

Waste Management

Waste Management 101 (2020) 54–65

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Co-gasification and co-combustion of industrial solid waste mixtures and their implications on environmental emissions, as an alternative management

Carlos F. Valdés [a], Gloria P. Marrugo [a], Farid Chejne [a,*], Alfredo Marin-Jaramillo [b], Jorge Franco-Ocampo [b], Liliana Norena-Marin [b]

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A R T I C L E I N F O

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Keywords:
Co-pelletization
Thermal co-processing
Primary sludge
Wood waste
Coal Boiler Ashes

A B S T R A C T

The primary sludge produced by the wastewater treatment plant of a pulp and paper mill has high physicochemical heterogeneity, which limits the efficiency of thermochemical methodologies for the final disposal of this residue. As a solution, co-pelletization of the Primary Sludge (PS) with two other principal Industrial Solid Residues (ISRs) of the plant, Coal Boiler Ashes (CBA) and Wood Waste chips (WW), was proposed as a way to valorize the PS for energy use, while reducing dewatering costs. The energy potential was evaluated through a series of thermal co-processing tests of disaggregated and pelletized mixtures. Due to their differing fixed-carbon-to-volatile-material ratios, combining the ISRs resulted in a reduction of up to 45% of the mass of the ISR generated, improving the disposal conditions and achieving a minimum thermal power of 5.0 MJ/Nm^3 through gasification. Finally, the environmental implications of the thermal co-processing of the wastes were assessed, finding very low impacts due to pollutant emissions, in accordance with the legal environmental regulations in force in Colombia.

1. Introduction

The pulp and paper industry has primarily used sanitary landfills for the final disposal of sludge coming from its industrial wastewater treatment plants (IWTPs), and for other Industrial

difficulties of this disposal mechanism are related to the environmental requirements (treatment of leachates and secondary pollution) and the criteria of economic sustainability of the final disposal sites (Mahmood and Elliott, 2006; Strezov and Evans, 2009; Chanaka Udayanga et al., 2018).

2020

Biomass Conversion & Biorefinery

Biomass Conversion and Biorefinery
https://doi.org/10.1007/s13399-021-01826-x

ORIGINAL ARTICLE

Experimental analysis of the effect of the physicochemical properties of paper industry wastes on the performance of thermo-conversion processes: combustion and gasification

Carlos F. Valdés [1] · Carlos A. Gómez [2] · Farid Chejne [2] · Alfredo Marin-Jaramillo [3] · Jorge Franco-Ocampo [3] · Liliana Norena-Marin [3]

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Abstract

This work analyzes the energy performance implications of the physicochemical properties and the mineralogical elemental composition of agro-industrial wastes in the form of pellets (ISR pellets) and pine bark chips (PBCh). ISR pellets were made from a mixture of industrial wastewater treatment plant (IWTP) primary sludge, coal boiler ashes (CBA), and wood waste chips (WW), which are wastes rich in inorganic material and with a usable energy potential. All these residues were obtained from the production processes of paper company (Smurfit Kappa Colombia). ISR pellets and PBCh were tested as individual and mixed fuels in the thermochemical gasification and combustion processes. Several synergistic effects were found through the co-processing of these fuels, resulting in improvements in the performance indices normally used for the energy assessment of waste, as well as substantial environmental impact and operational behavior improvements. These effects were predicted through fusibility correlations from the elemental composition of the inorganic content, particularly the low melting point salts precursor species and fusibility temperature, as developed for coal ashes. The results of experimental co-processing validated these predictions.

Keywords Thermo-conversion · Sintering · Slag · Environmental pollutant emissions · Co-processing

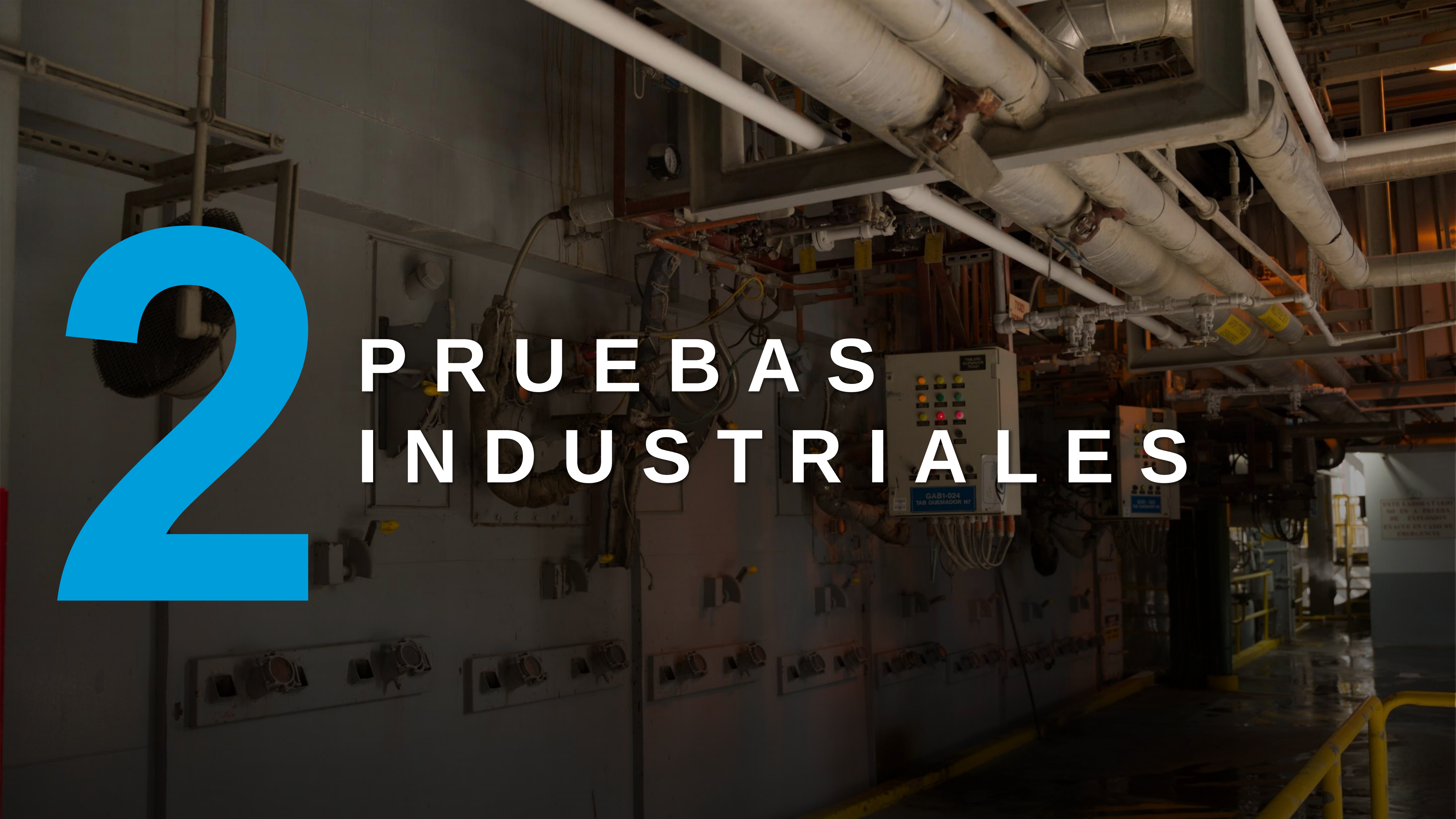
1 Introduction

The use of biomass as a fuel for heat and electrical power and as an input for the generation of value-added products are some of the most common methodologies for reducing dependence on fossil fuels and sustainable waste management.

per unit of energy as compared to fossil fuels. However, the energy exploitation of biomasses through thermo-conversion processes still presents challenges, such as environmental emissions (SO_x, NO_x, organochlorines, particulate matter, among others), competitive reactions promoting undesirable by-products (tars), and reactions with ashes (fouling,

2021

2 PRUEBAS INDUSTRIALES



Nueva prensa de lodos

Prensa de tornillo

A mayor sequedad, mayor eficiencia

- **Productividad:** 2.2 ton/mes
- **Inversión:** 2.2 MUSD
- **Consistencia de salida:** 40% – 50%
- Operativa en Diciembre 2019

Peletizadora piloto

Se adquirió una peletizadora para pruebas en planta:

- Capacidad: 150 kg/h

Inversión

- Equipo: 2000 USD
- Operario: 500 USD

Platos perforados

- Huecos: 212 huecos
- Diámetro: 8 mm
- Espesor: 25 mm

Producción de Pellets

Validación de resultados

Se produjeron 8 toneladas de pellets en 12 días, para la prueba inicial.

66%

Lodos de PTAR

33%

Cenizas de calderas de carbón

1%

Aserrín

→

Mezclador

→

Peletizadora

→

Pellets

Primer Ensayo de Combustión

Marzo 2021

Compatibilidad con el equipo actual

Alimentación manual de pellets en cangilones y fogoneros

Alimentación y quemado en parrilla viajera

Se verificó que los pellets no atravesaran la parrilla

Combustión completa de los pellets

Los pellets quemaron completamente

Suspensión del peletizado

Abril 2021

Se decide no peletizar y alimentar los residuos a granel

3 IMPLEMENTACIÓN

Co-combustión de biomasa

Antes

300 ton/día Carbón

Ahora

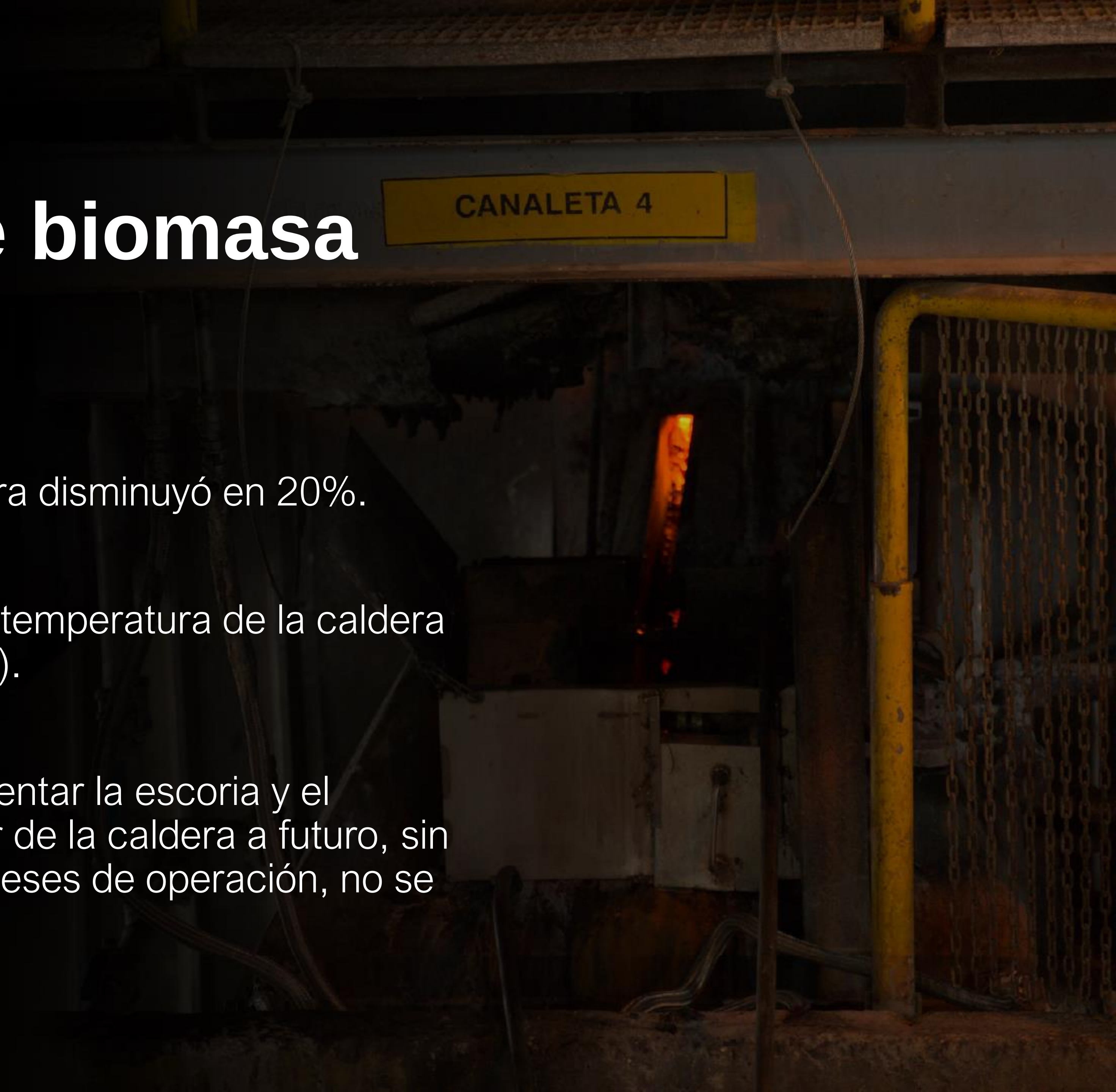
230 ton/día Carbón + **60** ton/día Madera, **40** ton/día Lodos, **16** ton/día Cenizas

-17% CO_2

Co-combustión de biomasa

Conclusiones iniciales

- La generación de la caldera disminuyó en 20%.
- No se ha incrementado la temperatura de la caldera (parrilla y sobrecalentador).
- La biomasa podría incrementar la escoria y el ensuciamiento en el hogar de la caldera a futuro, sin embargo, después de 6 meses de operación, no se ha evidenciado esto.



Co-combustión de biomasa

Ahorros

	LHV	Cost
Carbón:	28 MJ/kg	174 USD/ton
Mezcla de residuos:	16 MJ/kg	71 USD/ton

4,5 USD/GJ

VS

6,2 USD/GJ

150

kUSD/mes

4 PROYECCIONES

Descortezadora y Caldera de biomasa

- **Inversión:** US $92.7m
- **Mejora de EBITDA: US$21.2 m/año**
  16.9% IRR, con **5.2 años** de retorno

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