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EFFECT OF ELECTRON BEAM IN VISCOSITY PROPERTIES OF INVERTED LIQUID SUGAR

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INTRODUCTION

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SUGAR CANE *(Saccharum)*, BRAZIL

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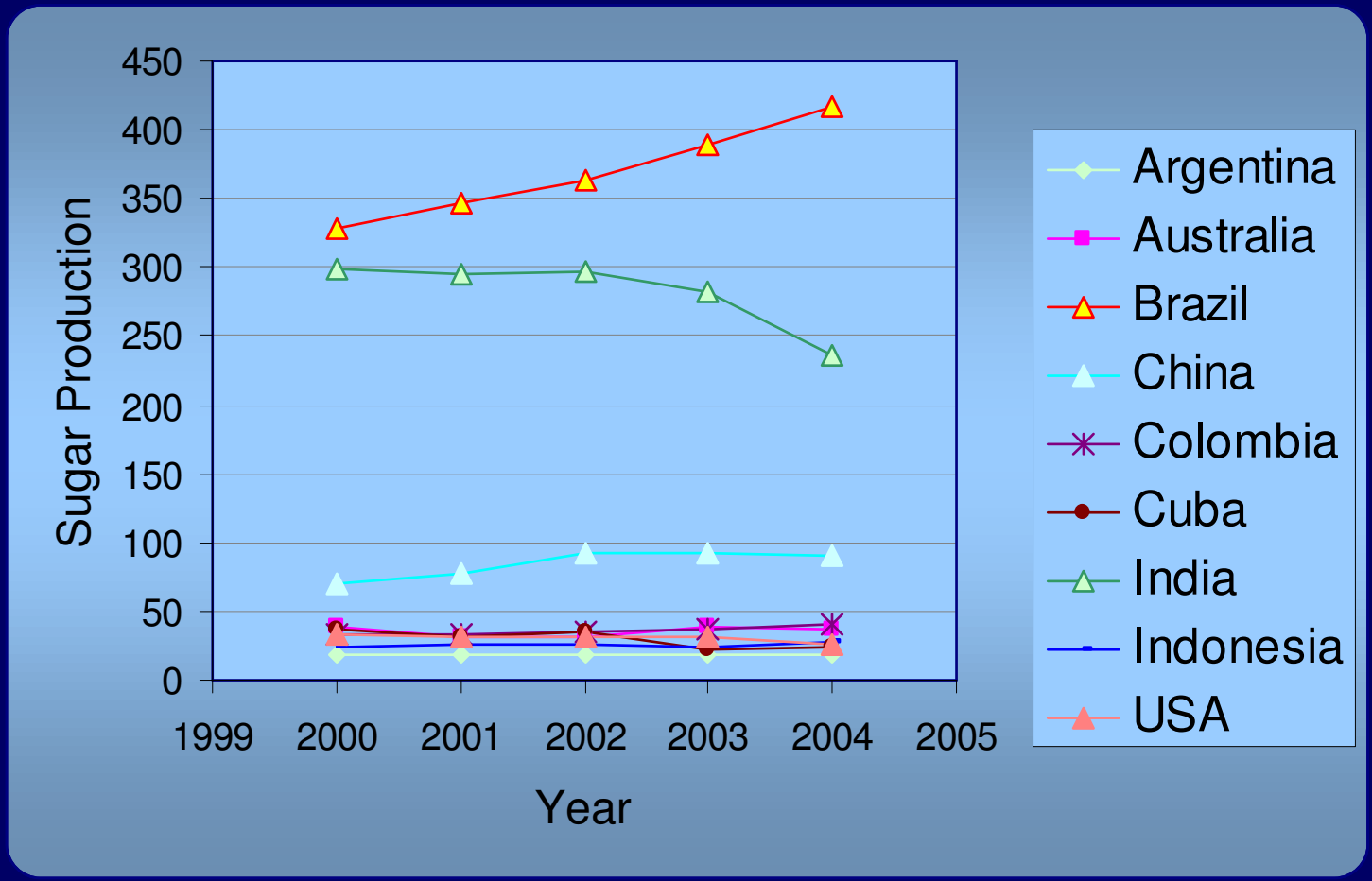


METHODOLOGY

Inverted Liquid Sugar Preparation

Dissolved in Non-chloride Water

↓

Treatment Purification

↓

Refined Liquid Sugar
(65-68% Sucrose)

↓

Controled Acid Hidrolysis

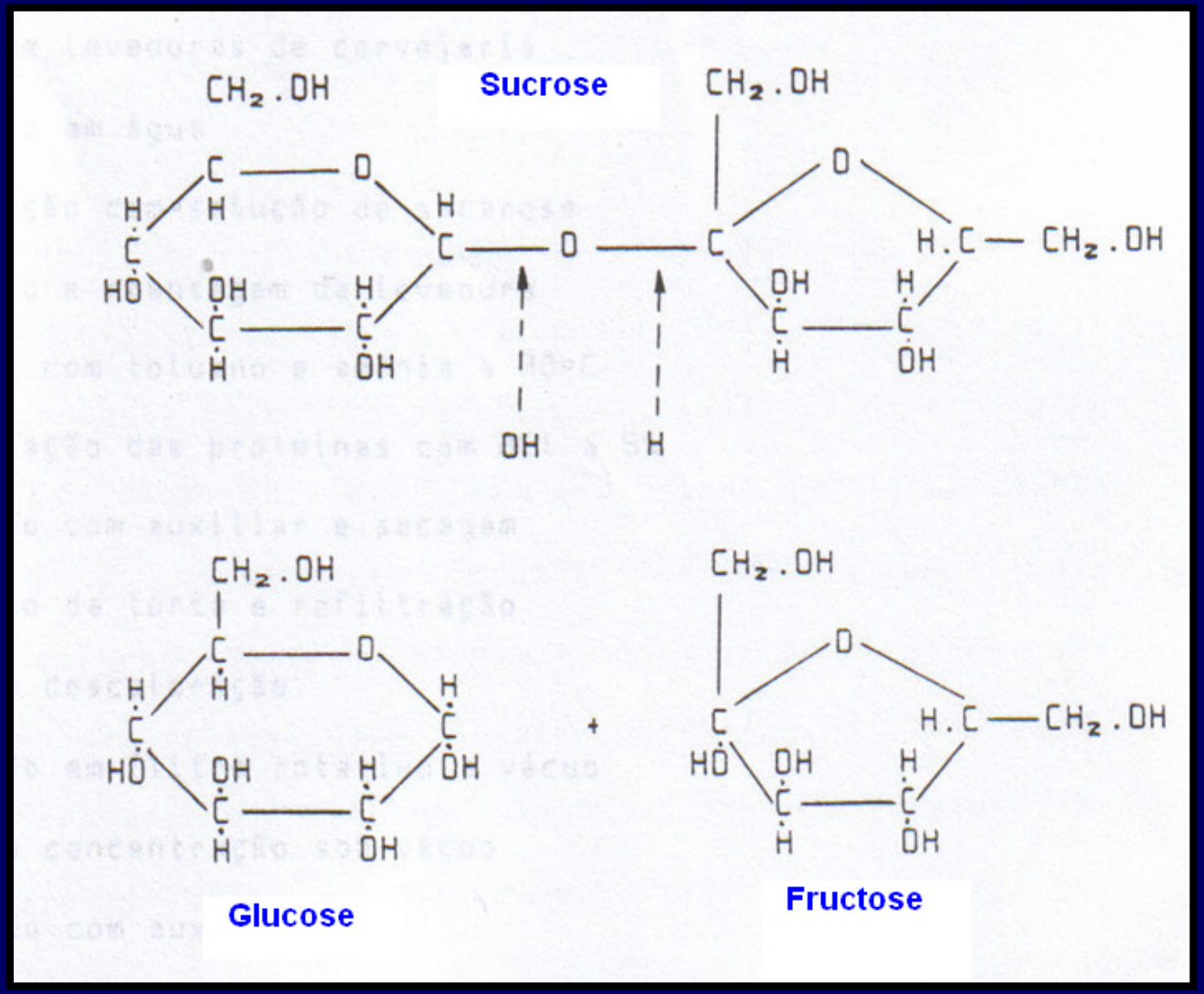
→

Inverted Liquid Sugar
(76% Solids)

←

Refined Cristal Sugar

INTRODUCTION



Inverted liquid sugar is obtained by acid or enzymatic hydrolysis of the sucrose, (process known as inversion)

INTRODUCTION

Characteristics of Inverted Liquid Sugar

- Better solubility than liquid sugar
- Good mix and homogenize of food with low quantity of water
- Higher sweetener power than sucrose, emphasizing the fruit flavor in juices.
- Texture improvement once structure is preserved as cristalization is minimized (size and number of cristalized sucrose)
- Color improvement ("golden brown", frutose becomes caramel at 60ºC, before other sugars).
- Stable flavor in acid products (carbonated beverages)

INTRODUCTION

Applications of Inverted Liquid Sugar

Application of this raw material varies since pharmaceutics products to food industries:

- Fruits conserves
- Biscuits/cookies
- Beverages
- Bakery

INTRODUCTION
Ionizing Radiation: Preservation Treatment

Critical point in Liquid Sugar Processing

- Storage Tank: avoid water vapor saturation in the surface (↓ condensation and sugar solution dilution), ***Marignetti & Mantovani, 1980***
- Ensure microbial quality: ultra-violet radiation in line, ***Stother, 1999***
- Ionizing irradiation: alternative treatment ***(few literature)***.

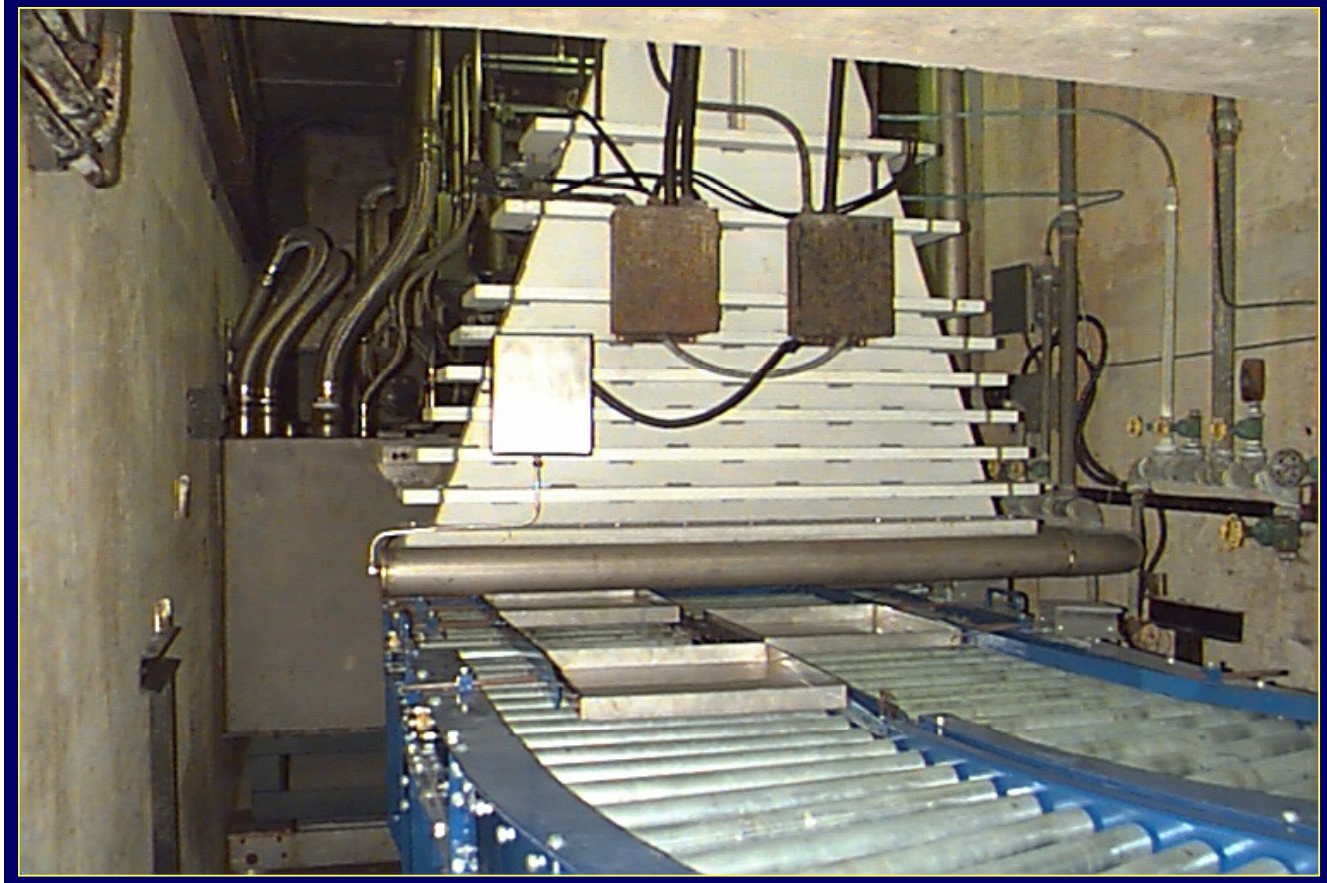
OBJECTIVE

The objective was to verify the effect of ionizing radiation on viscosity and rheological behavior of inverted liquid sugar.

Radiation from accelerator and from gamma source was applied to the samples in order to verify these effects.

The exact knowledge of the viscosity permits the correct choice of pumps and pipelines, valves and equipments dimensioning. The determination and control of viscosity of inverted liquid sugar is the parameter that assures the product control quality.

METHODOLOGY



Dynamitron Job 188 (Radiation Dynamics, USA)

Samples:

- Inverted liquid sugar, 69% (inversion) (Usina da Barra S/A, Brazil)

- Irradiation: Closed flasks, room temperature, normal atmosphere

Doses: 5 kGy and 10 kGy
- current: 2.74 mA
- dose rate: 11.19 kGy/s

Doses: 20 kGy, 30 kGy and 50 kGy
- current: 5.48 mA
- dose rate: 22.39 kGy/s

METHODOLOGY

- Samples: Inverted liquid sugar, 69% (inversion) (Usina da Barra S/A, Brazil)
- Irradiation: Closed flasks, room temperature, normal atmosphere
- Source: Gammacell 220, (AECL, Canada)
- Mean dose rate: 4.06kGy/h
- Doses: 5; 10; 20; 30 and 50 kGy
- Dosimetry: Routine dosemeter (Harwell, UK)

METHODOLOGY

- Brookfield viscometer, Model LV-DVIII, Serial Number R23289
- Spindle SC4-34
- Speed: 20 rpm (shear rate 5,6 seg^{-1})
- Temperature: 25ºC ± 0.5ºC, Neslab water bath.

RESULTS

Doses (kGy)	Viscosity ($N.s/m^2$)	
	Electron Beam	Gamma radiation
Control	2.799 ± 0.015^{a}	2.371 ± 0.075^{a}
5	2.507 ± 0.013^{b}	2.541 ± 0.086^{b}
10	2.542 ± 0.018^{c}	2.535 ± 0.060^{b}
20	2.717 ± 0.012^{d}	2.557 ± 0.119^{b}
30	2.715 ± 0.011^{d}	2.566 ± 0.154^{b}
50	2.918 ± 0.016^{e}	2.510 ± 0.101^{b}

Means followed by different letters are significantly different ($p \leq 0.05$).

RESULTS

	Absorbed doses (kGy)	Equation*	Correlation coefficient
Accelerator	Control	Y=2.4606.X + 1.9962	0.9986
	5	Y=2.4153.X + 0.6164	0.9991
	10	Y=2.5785.X – 0.0292	0.9983
	20	Y=2.6622.X + 0.5003	0.9998
	30	Y=2.5791.X + 0.7921	0.9993
	50	Y=2.6179.X + 1.7930	0.9988
Gamma Rays	Control	Y=2.2838.X + 0.7456	1
	5	Y=2.4878.X + 0.7156	1
	10	Y=2.4535.X + 0.7492	1
	20	Y=2.5829.X + 0.7234	1
	30	Y=2.5495.X + 0.6917	1
	50	Y=2.5126.X + 0.7222	1

RESULTS

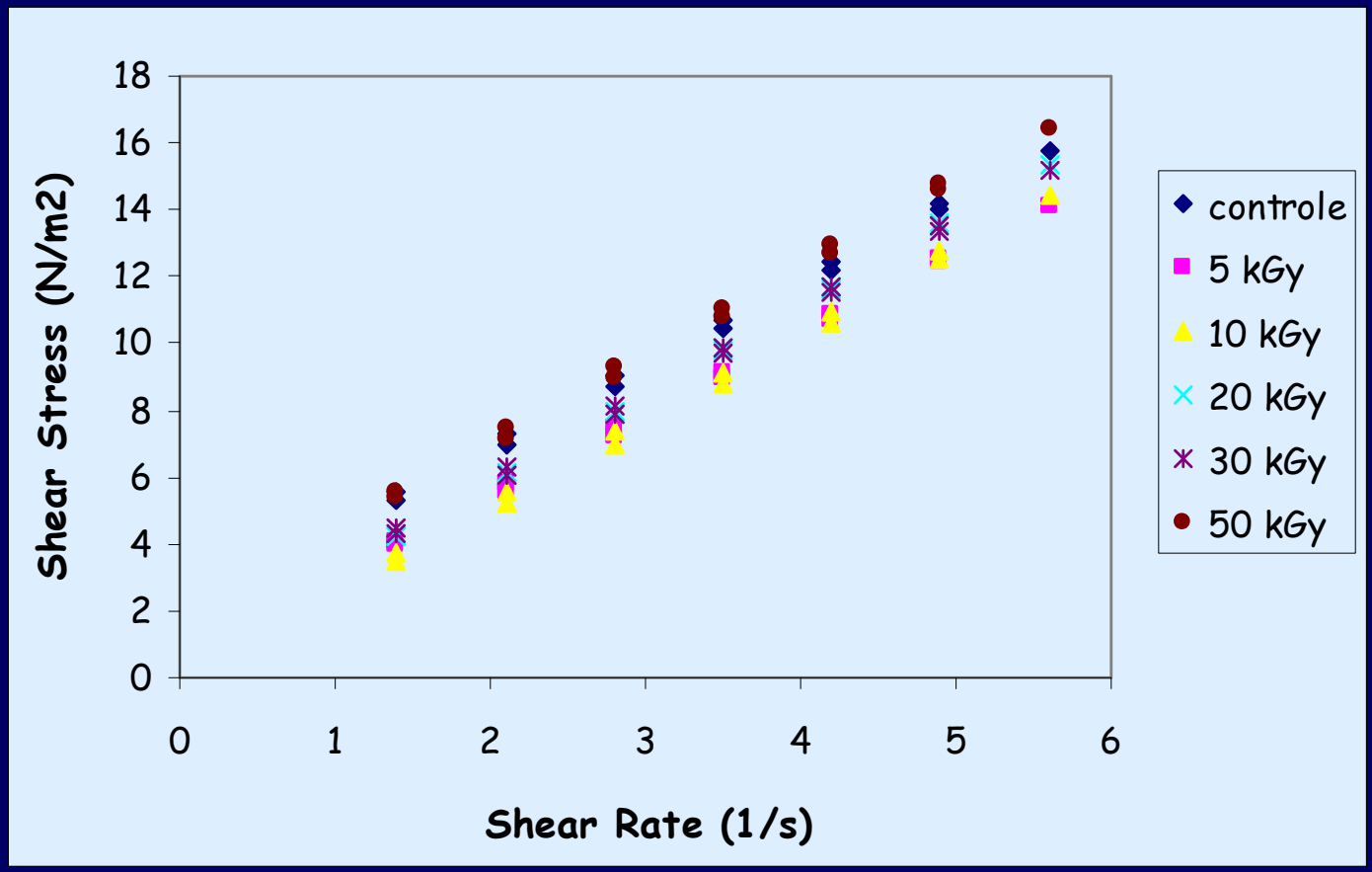


FIG. 1. Rheogram for inverted liquid sugar samples irradiated by ***ACCELERATOR OF ELECTRON BEAM*** *at 24.6 ±0.1°C.*

RESULTS

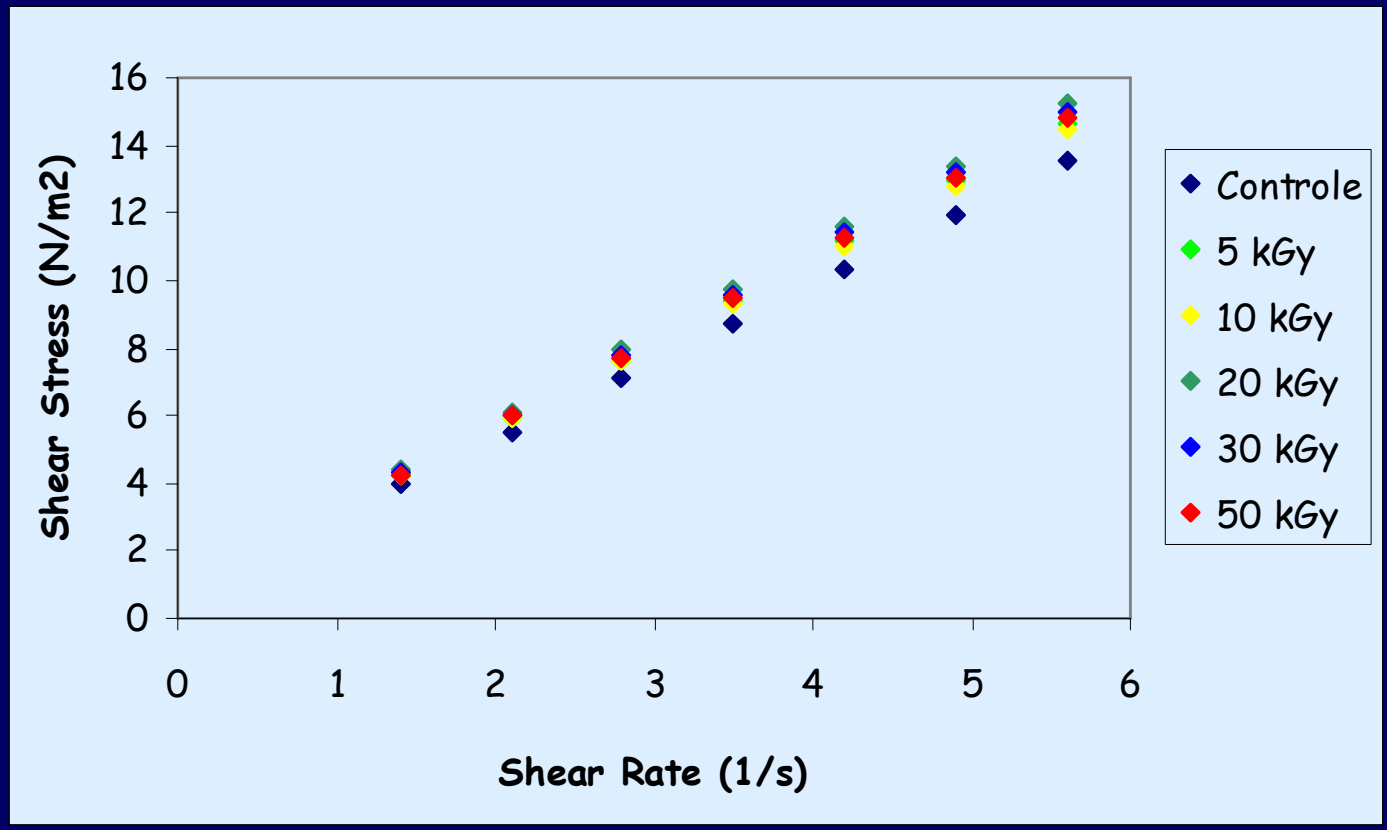


FIG. 1. Rheogram for inverted liquid sugar samples irradiated by ***GAMMA RAYS FROM COBALT-60 SOURCE*** *at 24.6 ±0.1°C.*

CONCLUSION

- Ionizing radiation, from accelerator or gamma rays, did not present markedly changes in viscosity values.

- Rheograms demonstrated that inverted liquid sugar has Newtonian behavior for both types of irradiation, at 24.6 ± 0.1 0C

- Viscosity inherent to different batches are more relevant than viscosity between doses.

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THANK YOU !

VIELEN DANK!