BRAZILIAN BIOCOMBUSTÍVEIS
Tecnologia Renovável Avançada

COMPARATIVE ENVIRONMENTAL REPORT
BBL DX EMISSIONS vs. BIODIESEL (SOYBEAN AND NEM)

1. Introduction

This report aims to present a **comparative environmental assessment** between different fuels used in internal combustion engines, with a special focus on the levels of atmospheric emissions of critical pollutants: **nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO)** and **carbon dioxide (CO_2),** in addition to relevant physicochemical parameters such as sulfur content, viscosity and oxidation stability.

The analysis includes the following fuels:

- **Neem Biodiesel B100**: produced from the oil extracted from the seeds of *Azadirachta indica*, commonly used in academic studies and comparison experiments.
- **B100 Soybean Biodiesel**: the main source of biodiesel in the Brazilian matrix, widely distributed and with intermediate environmental performance.
- **Diesel S10**: fossil fuel with low sulfur content, used as a market reference.
- **BBL DX B100**: new generation biofuel, developed and patented by Brazilian Biocombustíveis Ltda, with innovative technical characteristics, high operational stability and superior environmental performance.

The data presented are based on practical tests supervised by certified engineers (CREA), carried out with vehicles, vessels and generators powered exclusively with BBL DX, and on reference values extracted from the scientific literature and regulatory bodies such as ANP and CONAMA.

The comparison details the environmental indicators of each fuel, allowing a holistic analysis of the impact of its combustion in the context of decarbonization and energy transition goals.

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Comparison Table – Neem Biodiesel vs. Soybean vs. BBL DX

PARAMETER	NEEM BIODIESEL (B100)	SOYBEAN BIODIESEL (B100)	BBL DX (B100)
SOURCE	Neem seed oil	Refined soybean oil	Vegetable or used oil + higher alcohols
PRODUCTION PROCESS	Transesterification	Transesterification	Patented process with no glycerin or residues
SULFUR CONTENT (PPM)	<1	<1	**~3 ppm**
NO_x EMISSION (PPM)	2,187 to 2,485	~450 to 500 (various sources)	**32 ppm**
SO_x EMISSION (PPM)	~100 to 150*	~100*	**13 ppm**
CO2 EMISSION (%)	2,5%	2,3%	**0,7%**
CO PPM EMISSION	1600	1400	**490**
LOWER CALORIFIC VALUE (KCAL/KG)	~8,200	~8,600	**8.520**
VISCOSITY AT 40 °C (MM^2/S)	~4.5 to 5.5	~4.0 to 4.5	**3,81**
FLASH POINT (°C)	>100	~130	**36,5**
OXIDATION STABILITY (H)	~6 to 8	~6	**11.9 h**
ENGINE COMPATIBILITY	May require adaptations	Good compatibility (with mix limits)	**100% compatible without adaptations**

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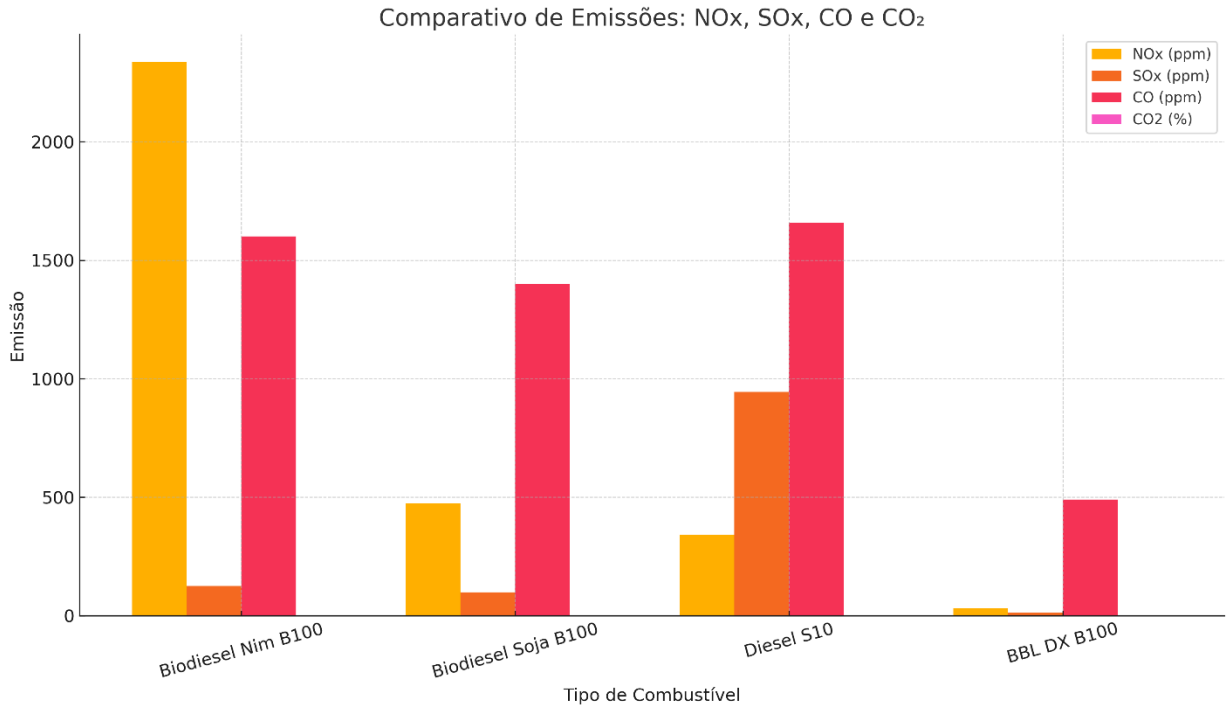

Concluding Note

Based on the data analyzed, BBL DX B100 biofuel demonstrates a vastly superior environmental performance compared to the other fuels evaluated. In particular, the following results obtained in the tests stand out:

- **NO_x emission:** only 32 ppm, compared to 475 ppm for soybean biodiesel, 2,336 ppm for neem biodiesel and 342 ppm for S10 diesel.
- **SO_x emission:** only 13 ppm, compared to 100–125 ppm for conventional biodiesels and 944 ppm for S10 diesel.
- **CO emission:** 490 ppm, versus 1,400–1,600 ppm for biodiesels and 1,660 ppm for S10 diesel.
- **CO_2 emissions:** 0.7%, compared to 2.3% (soybeans), 2.5% (nim) and 2.6% (S10 diesel).

In addition to the significant reduction in pollutant and greenhouse gas emissions, BBL DX also has improved performance in terms of viscosity (3.8 mm²/s), oxidation stability (11.9h) and full compatibility with conventional diesel engines, without the need for mechanical modifications.

Such characteristics, added to its clean production process and no toxic by-products, position BBL DX as an energy alternative of excellence, highly recommended for energy transition programs, carbon offsetting, clean logistics and public policies for environmental mitigation.

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