

## TECHNICAL SPECIFICATIONS BBL DX

### 1. TECHNOLOGY PRESENTATION

The technology underlying the new production system of Brazilian Biocombustíveis Ltda (BBL), is covered by a **Biofuel patent**, national phase INPI **BR 11 2022 011447-8 A2**, granted on **05/27/2025**, and PCT under the number **PCT/BR2019/050531**, entitled "Process, method and formulations for the production of an alternative plant-based fuel, animals, minerals or a combination thereof, also depleted, regenerated and/or genetically modified, algae and microalgae and/or oils derived from them, added to primary and/or higher alcohols, for use in generators and/or internal combustion engines for diesel motor vehicles, and/or turbines and/or boilers".



Unlike the traditional conventional Biodiesel production system, the technology uses a **combination process** (without temperature variations) between crude and/or virgin vegetable oil (or used and/or used mineral oil), and selected additives (alcohols, primary and/or superior) **without by-product (without glycerin removal)**, and **without the use of corrosive surfactants**. The result of the **process we have patented is a new economical and stable Biofuel (BBL DX)** for diesel engines and SAF, for different industrial and commercial sectors of use, on average with the same characteristics and performance as diesel and biodiesel, but definitely much less polluting and more efficient. An innovative biofuel, which **can be used in the internal combustion engines (100% and/or in a mixture with fossil diesel)** of the most modern cars and light vehicles **without the need for any modification in the engine or combustion system**.

The **BBL DX** can also be used in generators and/or diesel internal combustion engines for automotive and automotive traction and/or for power generation, in boilers, burners or turbines for the production of electrical or thermal energy. The tests we developed at our plant in Macaíba also proved a **reduction in fuel consumption and an increase in the power and efficiency of the vehicle's engine**.



**In addition, the balanced viscosity of our biofuel**, together with other elements that characterize our patent, **neutralizes the formation of carbon deposits in the injectors and piston rings, favoring excellent fuel spraying**.

## 2. BBL DX PROPERTIES (USINA EXPERIMENTAL, MACAIBA RN, BRAZIL)

In 2018, after much planning and years of laboratory tests carried out at the University of Rome, Italy's "La Sapienza", the first **experimental plant was inaugurated** in Macaíba, in the state of Rio Grande do Norte, Brazil. The initial objective was simple: to test the feasibility of producing at scale the biofuel that Professor **Dr. Andrea Festuccia** had



developed in the laboratory in Rome. During this period, the Chemical Engineer Professor at UNP and UFRN in Natal (RN), **Francisco Wendell Bezerra Lopes**, also joined the team, who contributed a lot, with his experience and knowledge, to the improvement and final development of the technology.

The experimental unit and its production underwent rigorous analysis in the laboratories at UFRN in Natal, CTGAS and UNP, and extensive performance tests, which included the use of biofuel in automobiles, agricultural machinery, diesel generators and even boats. These tests aimed to ensure that the biofuel was not only viable but also effective in a variety of conditions of use and temperatures, as well as meeting stringent performance and safety standards. Below we present a summary of the activity developed at the plant and in the laboratories of Macaíba (RN).

The Biofuel produced (**BBL DX**) can be marketed in different concentrations. Analyses and performance tests in motor vehicles were conducted with BBL DX (B30, B50, B75 and B100) referring, respectively, to fuel with concentrations of 30%, 50%, 75% and 100% of biofuel in mixture with common diesel. All products were characterized by accredited laboratories (LCL/UFRN and LQA/CTGás-ER) and then within the specifications of the National Agency of Petroleum, Natural Gas and Biofuels (ANP), as can be seen and summarized in the table below.

PROPERTIES ANALYZED <sup>1</sup>	BBL DX 100% (B100)	BBL DX 50% (B50)	DIESEL S-10
Specific Mass at 20°C, (kg/m <sup>3</sup> )	854,9	856,8	815 to 853
Total sulfur, (mg/Kg.min)	>3	4,4	15,0
Viscosity (mm <sup>2</sup> /s)	3,801	3,801	2 to 5
Flash Point (°C)	36,5	28	38
Higher calorific value (kCal/kg) <sup>2</sup>	9.714	8.210	10.885
Lower calorific value (kCal/kg) <sup>2</sup>	8.520	7.570	10.178
Pour Point (°C)	-27	-27	0 to -12
Cetane Number	41,6	42,4	48
Inspection of the wear of the injector nozzles of the VW S10 2014 Vehicle	Nonexistent	Nonexistent	-
Particulate matter (Opacity) of VW S10 2014 Vehicle (m <sup>-1</sup> )	-	0,26	1,7
Oxidation stability, h	11,9	9,6	6
SOX Emission (ppm) – Diesel Generator	-	13	944
NOX Emission (ppm) – Diesel Generator	-	32	780

### Technical Advantages

- Lower sensitivity to free fatty acids than other technologies
- Excellent cold flow properties
- Simple manufacturing process, and low power consumption
- Significantly lower initial capital investment than a conventional biodiesel plant
- There are no by-products produced (glycerin is not taken away in the production process)
- Product with lower corrosive component content
- No liquid and solid residue generated

### Environmental Advantages

- Development of a fuel with lower emissions than conventional fuel
- Low sulphur content (90% less polluting than S10 Diesel)
- Significantly reduces SOx emissions
- Reduces emissions that can cause acid rain
- Eliminates the formation of sulfates, which is a significant component of particulate emissions
- Significantly lower NOx (40-70%) than emissions from existing fuels on the market
- Chemical process for the elimination of components harmful to health and/or the environment present mainly in used lubricating oil.

## 3. EMISSION VALUES BBL DX

TABLE 2 – Emission values (SOX and NOX) per BBL D100.

ANALYSES PERFORMED	BBL D100	APPROX. MAX. LIMITS REQUIRED BY LAW*
SOX Emission (ppm)	13	1000
NOX Emission (ppm)	32	800

TABLE 3 – Emission values (CO and CO2) per BBL D100.

ANALYSES PERFORMED	BBL D100	DIESEL S10*
CO2 emission (%)	0,7	2,60
CO ppm emission	490	1660

TABLE 4 – Emission values (opacity test) per BBL D100.

ANALYSES PERFORMED	BBL D100	DIESEL S10*	MAXIMUM LIMIT REQUIRED BY LAW*
Opacity test	0,12	2,52	0,74

Table 8 - Comparison of emissions of the SsangYong Kyrion 2.0 4x4 vehicle using BBL 50 and Diesel Additive (S10)

\*Average S10 emission values, source: <https://siambiental.ucs.br/congresso/getArtigo.php?id=228&ano= quarto>

\* These values refer to estimated emissions in parts per million (ppm) for a generator such as the **Vonder GDV 5500**, assuming that it operates close to the maximum limits established by CONAMA Resolution 382/2006. For accurate data, direct analysis of the gases with field measuring equipment is recommended.

Based on CTGAS tests and average emission values of Diesel S10:

- **NO<sub>x</sub>**: BBL100 reduces emissions by approximately **96.4%**
- **SO<sub>x</sub>**: BBL100 reduces emissions by approximately **97.8%**

These data demonstrate the **exceptional environmental efficiency** of the BBL100 technology compared to fossil diesel, making it an extremely attractive solution for markets with emissions restrictions and energy transition policies.

## 4. CONSUMPTION TEST

We carried out 2 fuel consumption tests (the same route with a full tank of 75 liters), the first with the S10 Diesel Additive, and the second with our BBL D50. The data show (see figure below) that using BBL 50 ***we obtained a consumption approximately 10% lower than S10 diesel fuel in the market.***

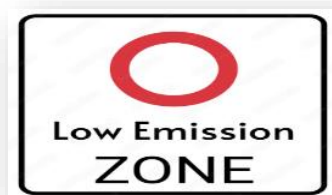


Table 5 – Consumption test (Diesel S10 vs. BBL 50)

FUEL CONSUMPTION SSANGYONG KYRON 2.0 VEHICLE CAR MODEL YEAR: 2010	BBL 50 DECEMBER 2018	DIESEL S10 DECEMBER 2018
75 LITERS	632.20 KM	548.70 KM



## 5. DYNAMOMETER TEST

With the same vehicle, we carried out performance tests with a dynamometer at **the JM POWER CAR in Natal**, accredited by DETRAN (RN), the first with Diesel S10 and the second with our new biofuel BBL 50 (50% BBL DX). The data show (Table 9) that the two fuels with the same number of revolutions per minute (RPM) develop, on average, almost the same number of HPs, demonstrating no loss of power from the BBL 50, compared to Diesel S10.



Car Dynamometer test at JM POWER CAR BOSH in Natal, Brazil

Table 6 Engine performance comparison between the Diesel Additive on the market and our BBL 50.

ANALYSIS CARRIED OUT AT JM POWER CAR NATAL	BBL D50 DATE 02.01.19	DIESEL S10 DATE 11.12.18
DYNAMOMETER TEST	3909 R.P.M. 128.0 HP	3959 R.P.M. 128.2 HP

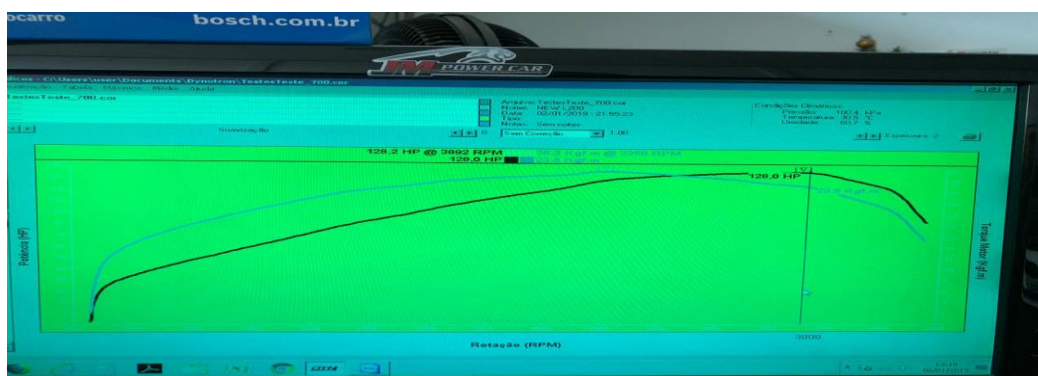


Figure 6 at the top of the dynamometer test performed with our BBL 50 Biofuel on 02.01.2019

## 6. CONCLUSION

### BBL DX as a New Generation Technological and Environmental Solution

BBL DX technology represents a significant break in the current paradigm of renewable fuels. Differentiating itself from both fossil-based S10 diesel and traditional biodiesel, BBL DX combines **energy efficiency, industrial simplicity, economic viability and environmental superiority**, being one of the most promising solutions for the global energy transition.

Compared to the Diesel S10, the BBL DX features:

- Reduction of up to **96.4% of NOx emissions** and **97.8% of Sox emissions** and **300% of the sulfur rate**, making it drastically less polluting;
- Reduction of **CO2 emissions by more than 70%** and **CO emissions by 67%**;
- **Emission opacity 20 times lower** than the legal limit (0.12 vs. 2.52), showing less particulate matter formation;
- **Lower consumption** per kilometer driven (~10% lower), according to comparative tests with real vehicles;
- **Full compatibility with existing diesel engines**, no need for retrofitting or conversion.



Compared to conventional biodiesel, BBL DX demonstrates relevant advantages:

- **Simpler and cleaner manufacturing process**, without glycerin production or solid/liquid waste;
- **Low sensitivity to free fatty acids**, allowing the use of more affordable raw materials (including waste oils and minerals);
- **Lower energy consumption and lower initial CAPEX**, facilitating the implementation of new production units;
- **Greater oxidative stability** (11.9h vs. 6h of Diesel S10), extending the useful life of the stored fuel;
- **Optimal viscosity and flowability**, with a pour point of -27°C, ideal for cold weather operations without the need for additives.

From a performance point of view, dynamometer tests proved that the BBL 50 (50% mixture with diesel) **maintains the same power as fossil diesel**, with the same torque and rotation, eliminating the concern of loss of operational performance.

In addition, BBL DX actively contributes to ESG policies, being an **environmentally friendly, economically viable and socially integrated** technology, with the potential for direct application in sectors such as road transport, rail, power generation and aviation (SAF).

With two fronts of action – production of **SAF** (European and Brazilian Market) and **GREEN DIESEL**, regulated by **Law 14,993/24**, and authorization of biofuels for diesel generators in Brazil – **Brazilian Biocombustíveis Ltda. (BBL)** positions itself as a pioneer company in the sustainable fuels sector.

BBL's ability to serve both the local and international markets, coupled with alignment with Brazilian and European legislative initiatives, reinforces its commitment to sustainability and innovation. These strategies make BBL a key player in the global energy transition.

# ATTACHMENTS

## EXPERIMENTAL UNIT (MACAÍBA, RN, BRAZIL)

Our existing facility was built in 2018 in the industrial area of Macaíba, RN (Brazil). The complex occupies a physical area of approximately 500 m<sup>2</sup>. The complex has a potential production capacity of 2000 liters per hour, and was planned to be used only for quality and reliability tests of vehicular biofuels and equipment (see the photos below and the analysis of the biofuel tests in the attachments)





Governo do Estado do Rio Grande do Norte  
Secretaria de Estado do Meio Ambiente e Recursos Hídricos  
Instituto de Desenvolvimento Sustentável e  
Meio Ambiente do Rio Grande do Norte

Rondinelle Silva  
Diretor Geral



### Licença de Regularização de Operação

Nº 2018-122801/TEC/LRO-0137

O Instituto de Desenvolvimento Sustentável e Meio Ambiente do Rio Grande do Norte, com fundamento na Lei complementar Estadual - LCE nº. 272, de março de 2004 e suas posteriores alterações, Legislação Federal e, ainda, consubstanciado no Parecer Técnico fundamentado, dentre outros, constante dos Autos Processuais nº 2018-122801/TEC/LRO-0137, ao Empreendedor infraidentificado, sob as condições abaixo relacionadas, cujo descumprimento implicará falta de natureza grave, acarretando a suspensão automática da presente licença.

#### IDENTIFICAÇÃO DO EMPREENDEDOR E EMPREENDIMENTO

Nome do Empreendedor:	BRAZILIAN BIOCOMBUSTÍVEIS LTDA
CPF/CNPJ:	29.425.965/0001-08
I.E.:	
Proprietário do Empreendimento:	
Endereço do Empreendedor:	Av. Major Antonio Delmiro, nº 375, Quadra 007, Lote 2667, Alfredo Mesquita, Macaíba/RN
Endereço do Empreendimento:	Av. Major Antonio Delmiro, nº 375, Quadra 007, Lote 2667, Alfredo Mesquita, Macaíba/RN
Caracterização do Empreendimento:	Indústria Recicladora de resíduos oleosos com objetivo de transformá-los em Biocombustíveis. Com área total de 433,4 m², sendo 254,14 m² de área destinada a produção e 78 m² de área destinada a administração.

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5. O empreendedor é responsável em adotar medidas preventivas de combate a princípio de incêndios em conformidade com a legislação PERTINENTE e as normas técnicas aplicáveis, sendo obrigado a manter o AVCB - Atestado de Vistoria do Corpo de Bombeiros VÁLIDO, no estabelecimento, em local visível, para fins de fiscalização, tendo ciência que é competência dessa instituição: as vistorias, inspeções nas instalações do Empreendimento e nos demais equipamentos referentes a combate a incêndio e sua aprovação;
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10. O empreendedor deverá apresentar semestralmente a este instituto a análise do teor de óleos e graxas do efluente após tratamento na caixa separadora;

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**Brazilian Biocombustíveis Ltda**

CNPJ: 29.425.965/0001-08 | IE: 20.485.828-3

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### CONDICIONANTES

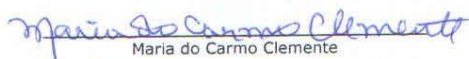
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Natal (RN), 09/11/2013

  
Maria do Carmo Clemente  
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