Universitatea Transilvania din Brașov
FACULTATEA DE INGINERIE MECANICĂ

Departamentul de Autovehicule și transporturi

HABILITATION THESIS

Biofuels and Road Safety: Challenges and Solutions in the Context of Sustainable Mobility

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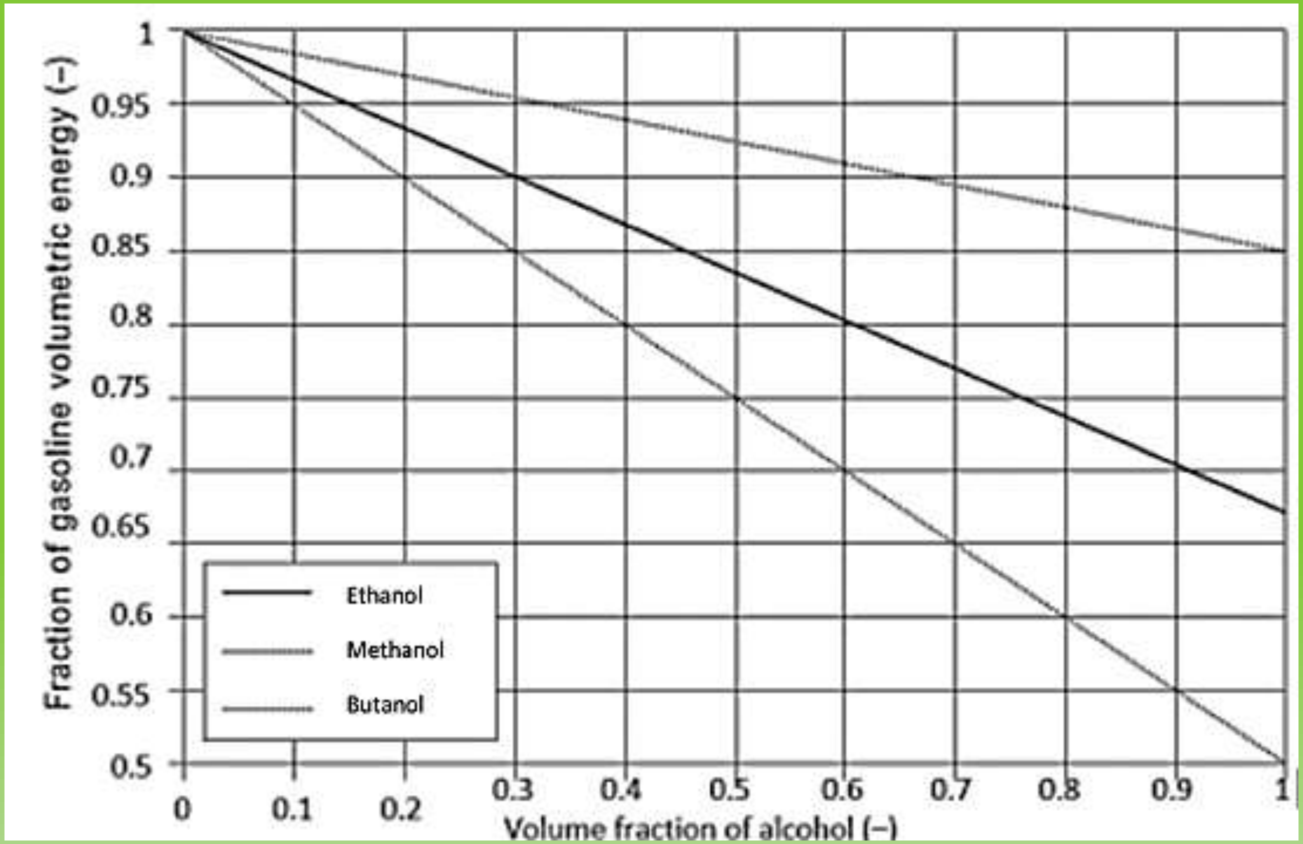
CONTENTS

Chapter 1. Alternative Fuels

Biofuels classification	Feedstocks	Production technology	Fuels
First generation	Starch & sugar crops Vegetable oils	Fermentation Distillation Transesterification Hydrogenation Fischer-Tropsch Gasification Hydrolysis Pyrolysis Biotechnology	Biomethanol Bioethanol Butanol Biodiesel Vegetable oil Jet fuels (ATJ)
Second generation	Agricultural residues Forest residues Sawmill residues Wood waste Municipal solid waste		
Third generation	Algae		
Fourth generation	Engineered plants and microorganisms		

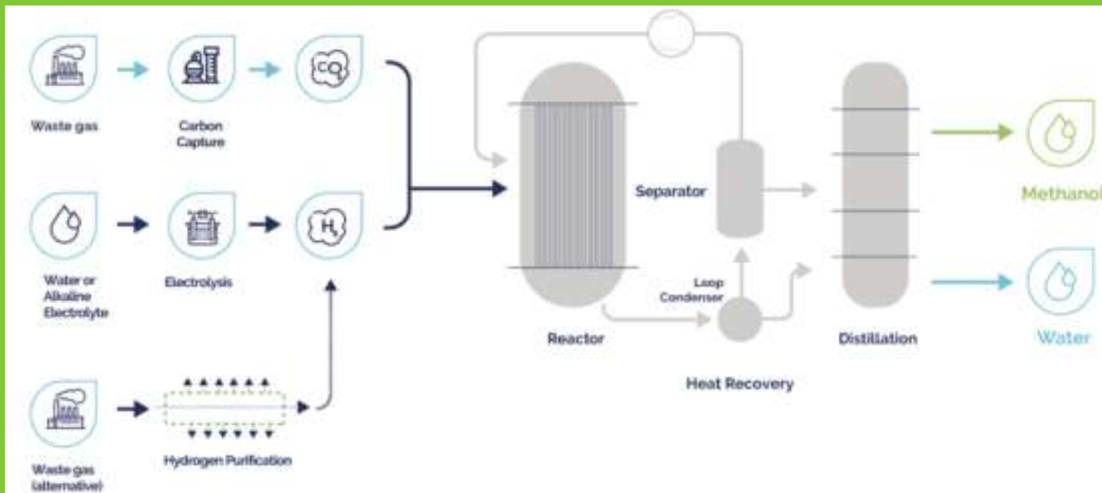
The annual global biomass production is considerably higher, about 5-7 than the total fossil energy consumption.

Alcohol – gasoline blends: variation of volumetric energy density



In the case of 10% by volume alcohol concertation in gasoline, the volumetric energy density relative to gasoline is diminished by approximately 2% for butanol, 3,5% for ethanol and 5% for methanol. For 85% alcohol concentration the reduction of volumetric energy density is as follows: 13% for butanol, 28% for ethanol and 43% for methanol. This reduction of volumetric energy density implies engine optimization in order to overcame an increased fuel consumption.

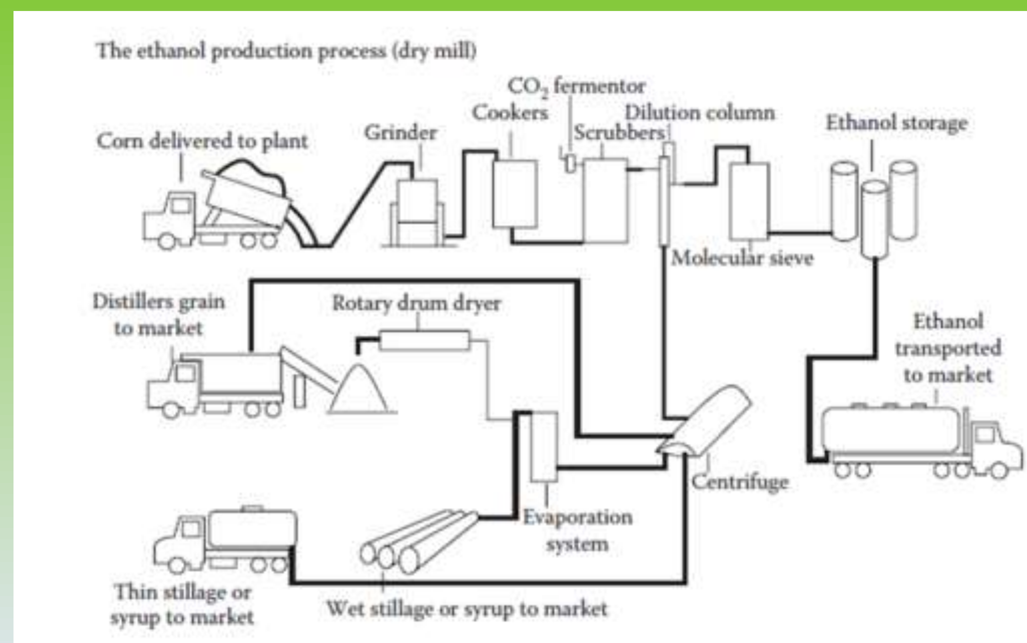
Biomethanol - Bioethanol



Carbon Recycling International plant in Iceland being the global leader in CO_2 to methanol technology

Approximately 70% of the world's biofuels production is represented by ethanol.

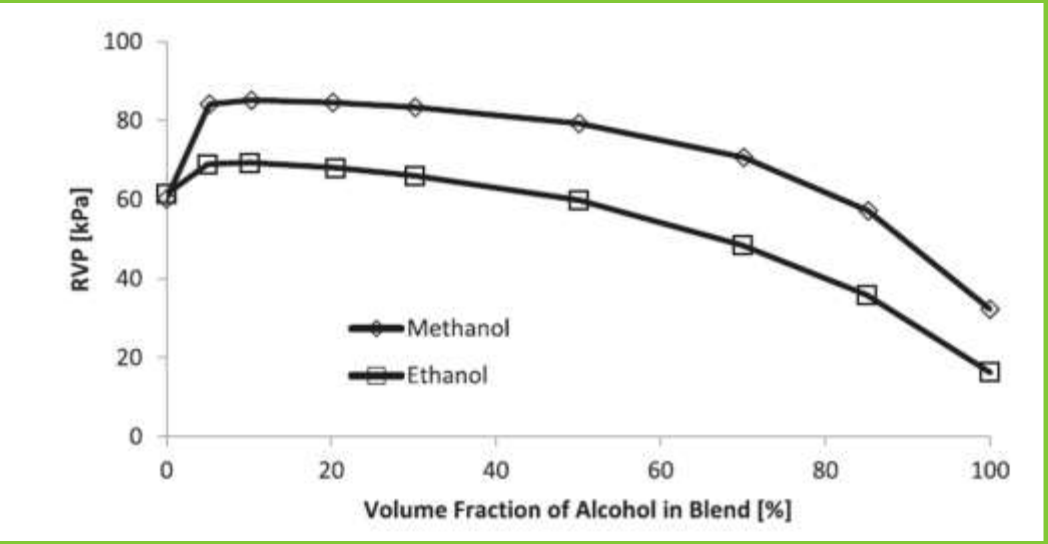
Fermentation followed by distillation is the most common method for turning biomass into ethanol. Fermentation is a biochemical conversion process that uses microorganisms (enzymes or bacteria) to decompose biomass.

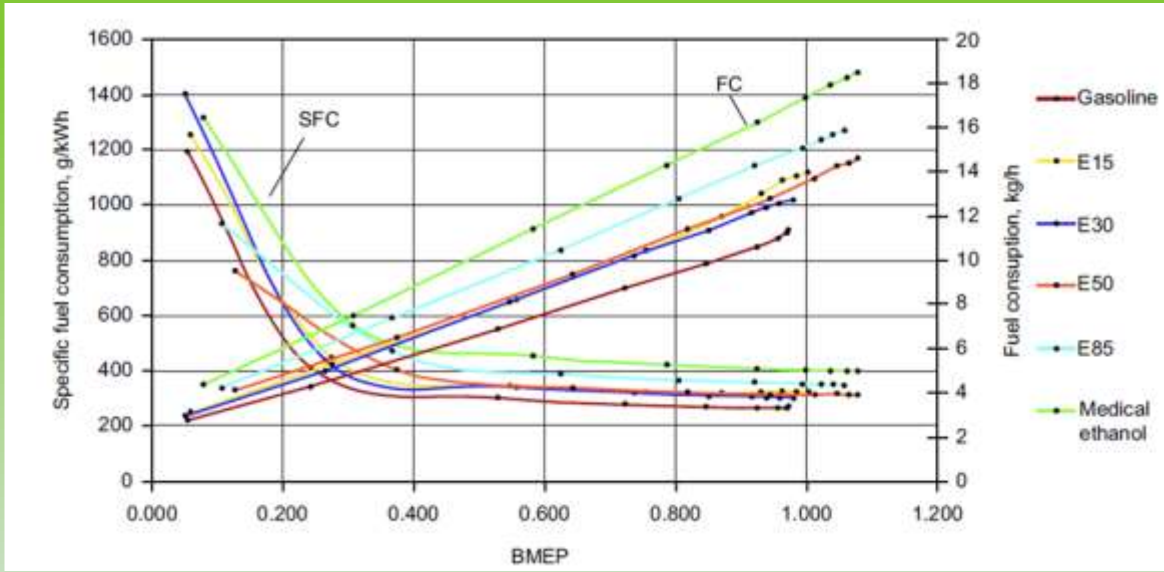


Biomethanol - Bioethanol

+ Biomethanol -	+ Bioethanol -
• high heat of vaporization and great autoignition resistance - charge cooling effect	
• raises intake air density, boosts volumetric efficiency	
• octane booster	
• increased boost pressure	
• burning cleaner	
• hydrogen carrier	
• low vapor pressure	
• low energy density	
• low cetane number	
• heavy fraction free content	

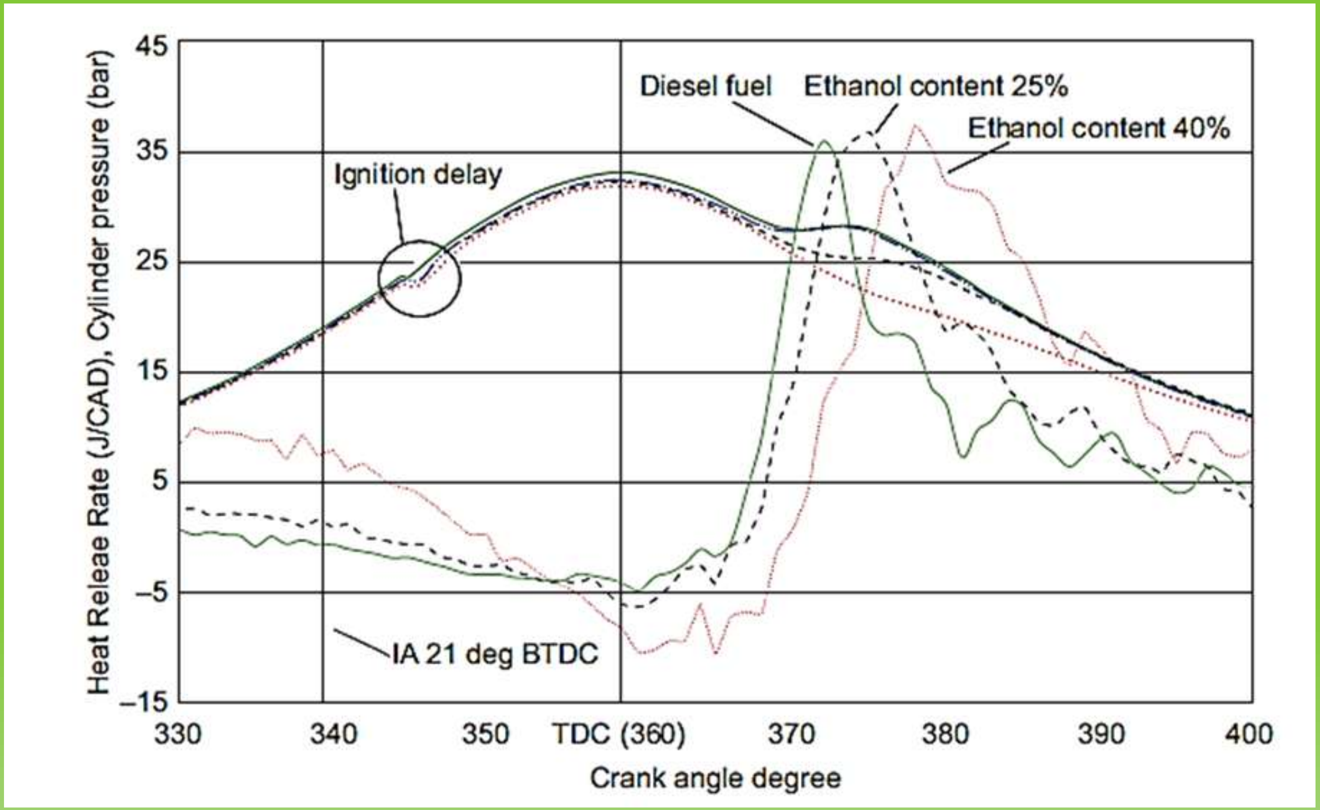
The Reid vapor pressure variation depending on the alcohol concentration by volume in gasoline mixture.





The specific fuel consumption is higher int the case of ethanol mixtures, especially when E50 – E100 fuels are used. In order to decrease the specific fuel consumption, it is necessary to make changes in engine mapping.

Combustion of diesel and ethanol blends



The difference in combustion pressure evolution, can be observed especially between 370 and 390 degrees. The pressure magnitude is proportionate with the amount of ethanol in the air - fuel mixture, the increase of ethanol quantity determines a pressure drop in the engine cycle. Regarding the heat release rate, it is evident that the rise in ethanol in the air - fuel mixture causes a corresponding delay in energy release. Furthermore, the heat release rates graphs make it clear that burning an ethanol-containing air - fuel mixture takes longer.

Ethers

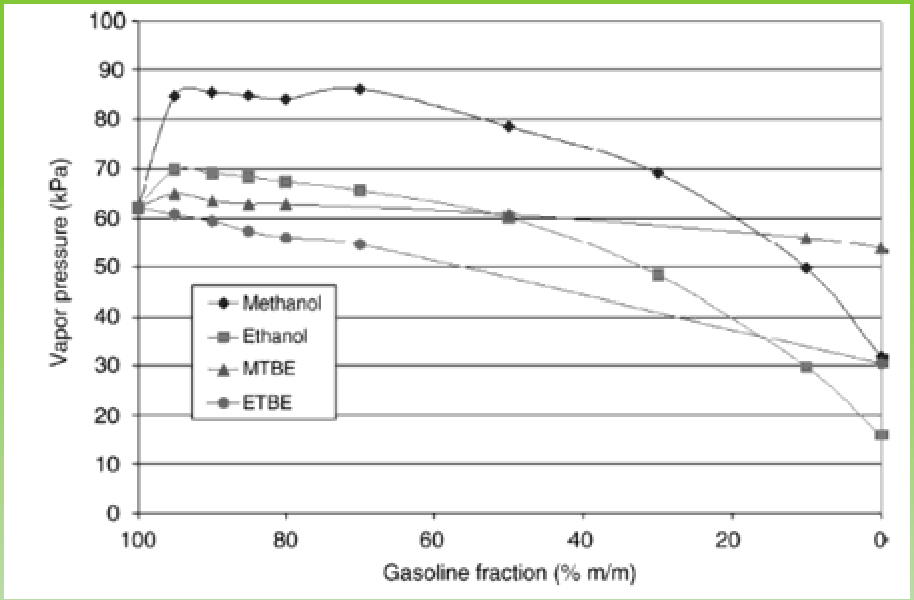
$$R'\text{-}OH + R\text{-}OH \rightarrow R'\text{-}O\text{-}R + H_2O$$

Currently the following products are used as fuel components

- ✓ MTBE - methyl tert-butyl ether – CH_3-O-C_4H_9;
- ✓ ETBE - ethyl tert-butyl ether – C_2H_5-O-C_4H_9;
- ✓ TAME - tert-amyl methyl ether – C_5H_{11}-O-CH_3;
- ✓ TAEE - tert-amyl-ethyl-ether – C_5H_{11}-O-C_2H_5.

	MTBE	ETBE	TAME	TAEE
Molecular mass	88	102	102	116
Oxygen, (wt%)	18.2	15.7	15.7	13.8
Boiling point, (°C)	55	72	86	102
RVP[a] blending, (kPa)	55.2	27.6	10.4	9.0
Density, (kg/l)	0.74	0.75	0.77	0.77
RON, blending	117	119	110	108
MON, blending	102	103	99	95

a) Reid vapor pressure.



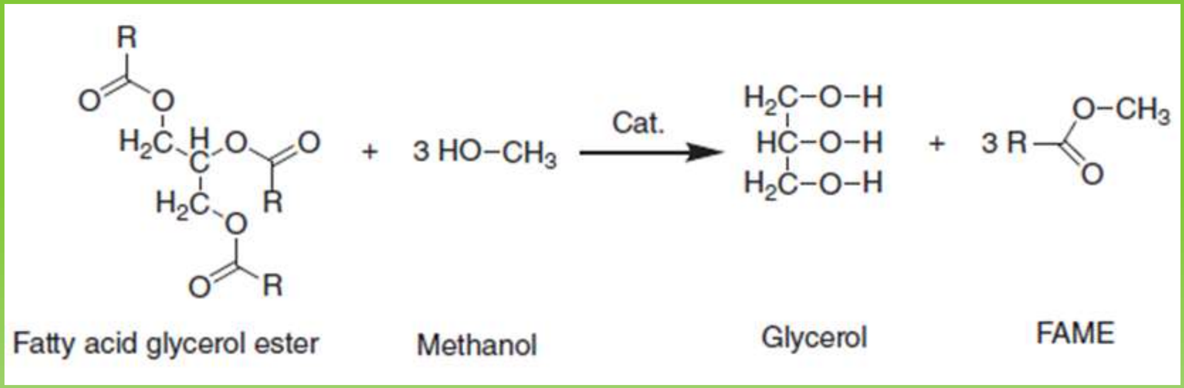
Ethers do not undergo phase separation in the presence of water, unlike methanol and ethanol. They have no harmful effects over the elements of the fuel supply system and are miscible in gasoline.

MTBE, ETBE are mainly used as blending components for gasoline due to their high octane number (octane booster).

Biodiesel

Biodiesel can be classified according to the type of feedstock used for its production. By this criterion it can be:

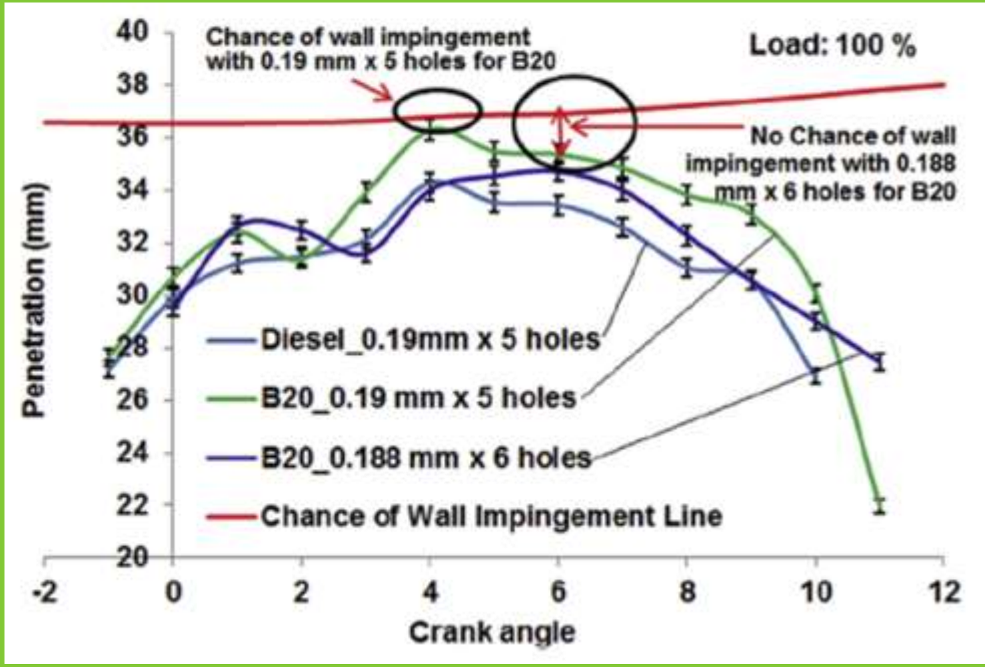
- ✓ first generation biodiesel: it is produced from vegetable oil such as rapeseed, soybeans, palm oil, sunflower, and peanut;
- ✓ second generation biodiesel: are typically made from nonfood crops, forestry wastes, biomass sources, waste vegetable oils and fats, and other inedible feedstocks.
- ✓ third generation biodiesel: is obtained from algae.

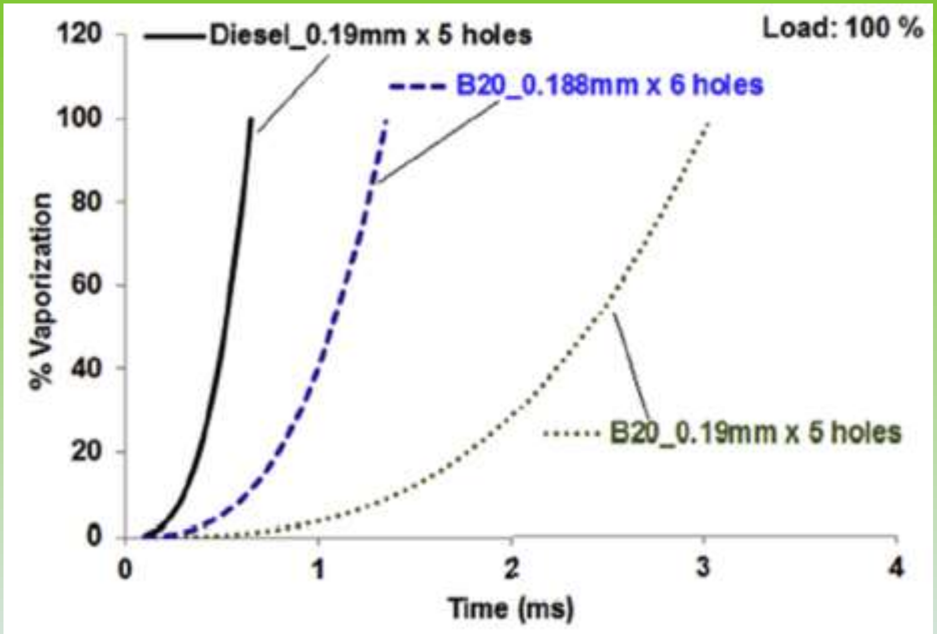


The transesterification reaction – biodiesel production

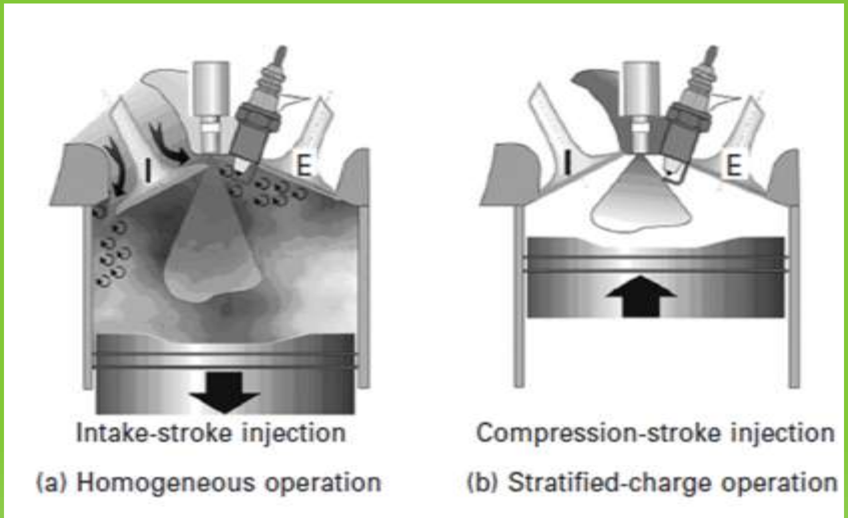
Transesterification is one of the most popular ways to reduce the viscosity of fatty acids, that represents a significant issue with the usage of pure fatty acids and vegetable oils.

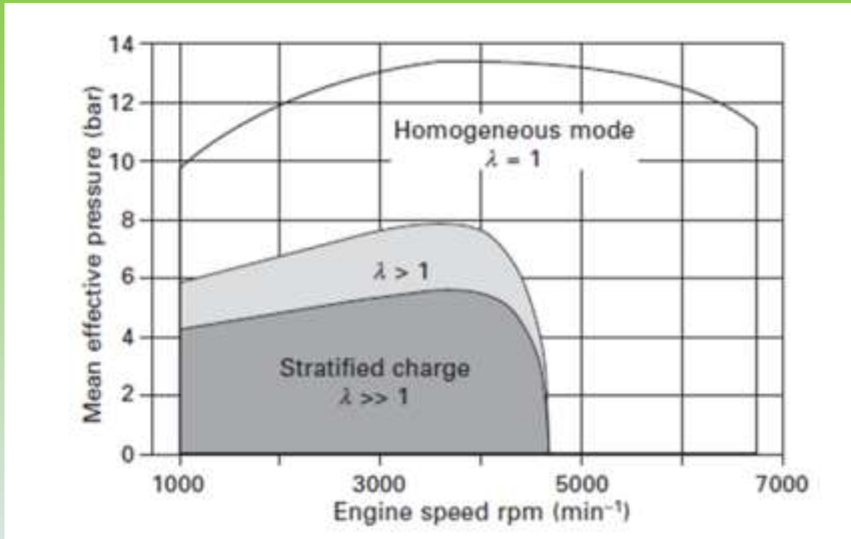
+ Biodiesel -
+ Higher cetane number 45 - 67
+ Higher cloud point (CP) and pour point (PP)
+ Low toxicity and high biodegradability
+ Renewability
+ Relative safety (its higher flash point)
+ Lubricity
- Superior breakup length
- Lower energy content
- Inferior fuel atomization due to higher viscosity
- DPF regeneration (oil dilution)
- Higher nitrogen oxide (NO_x) emissions





Researches regarding the performances of a turbocharged GDI engine fueled with E10





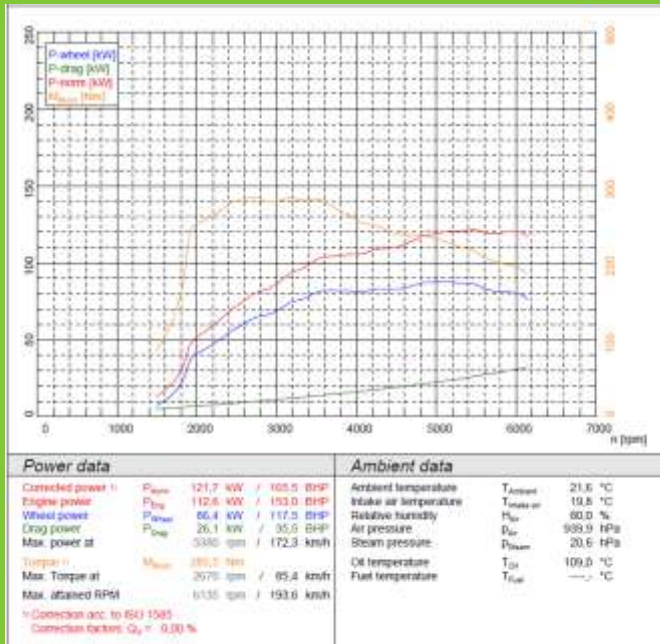
When fuel blend is injected during intake stroke, the charge cooling effect improves the engine volumetric efficiency. When the fuel blend is injected in the combustion chamber at the end of compression stroke, cylinder pressure will register a drop (cooling effect).

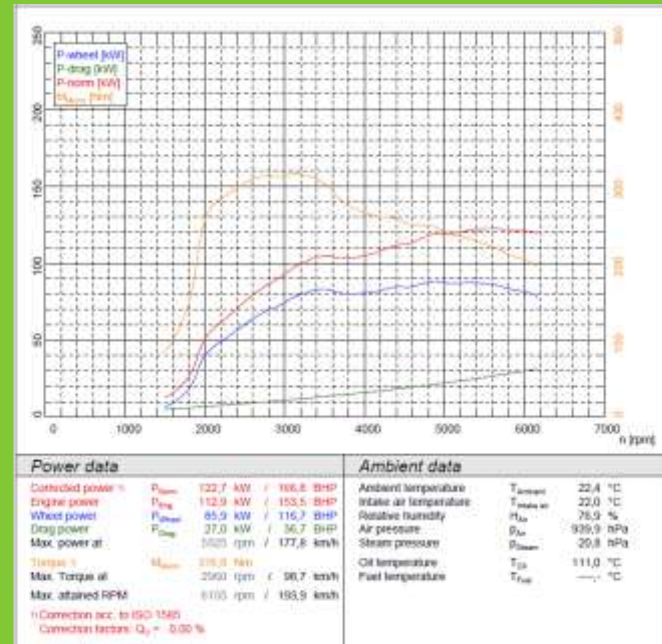
Ford Focus equipped with an EcoBoost gasoline direct-injection turbocharged 1.6-liter four in line cylinder engine, power 134 kW, at 6000 rpm. The EcoBoost engine features double overhead belt-driven camshafts and variable intake and exhaust valve timing. Displacement: 1,596 cm^3; bore x stroke: 79 x 81,4 mm.

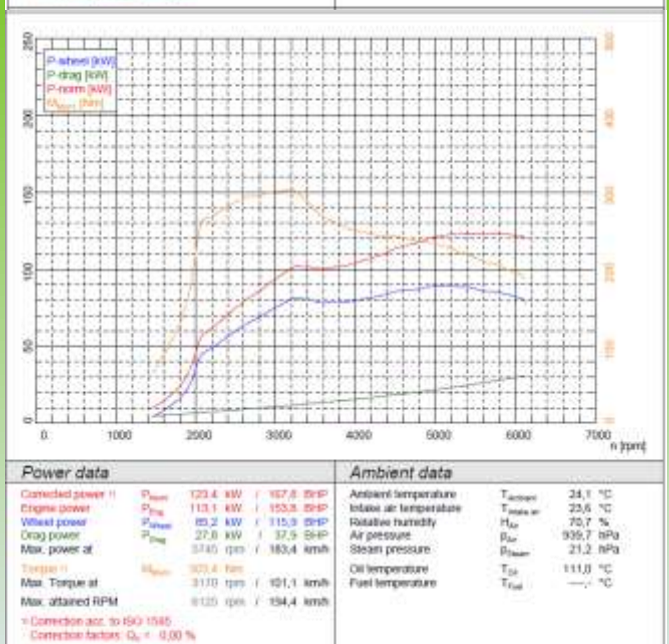
The test car on the dynamometric MAHA LPS 3000 test bench

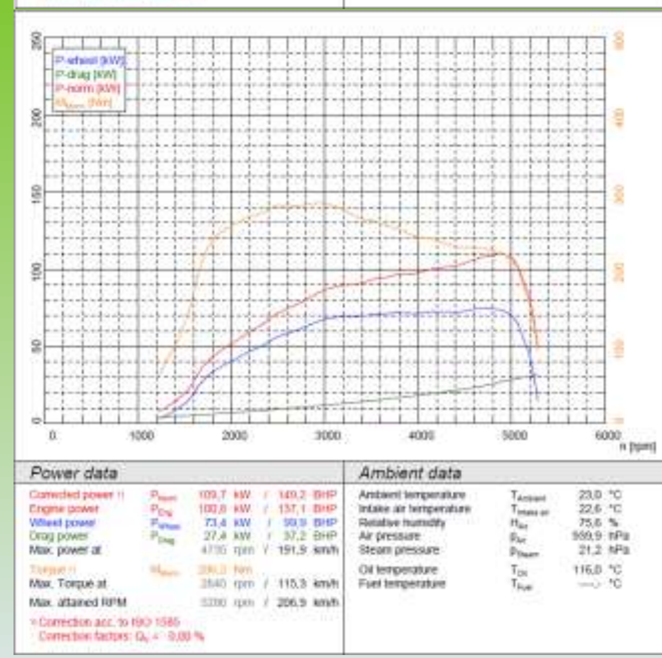
The LPS 3000 is available in various versions for performance testing of cars. Depending on the version, wheel power from 260 kW to 520 kW with a max. test speed of 260km/h can be tested.

Test results for E10, RON 95

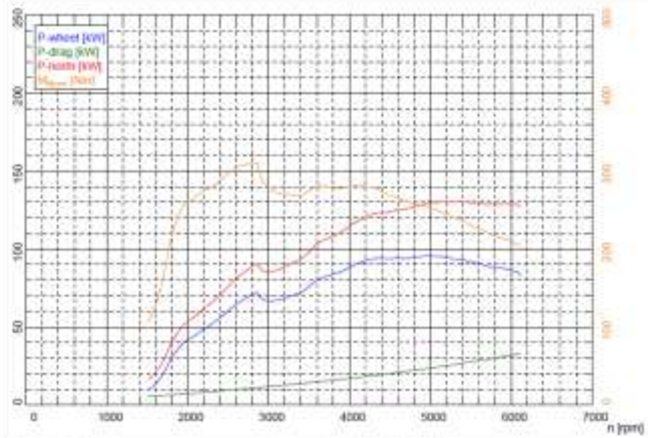








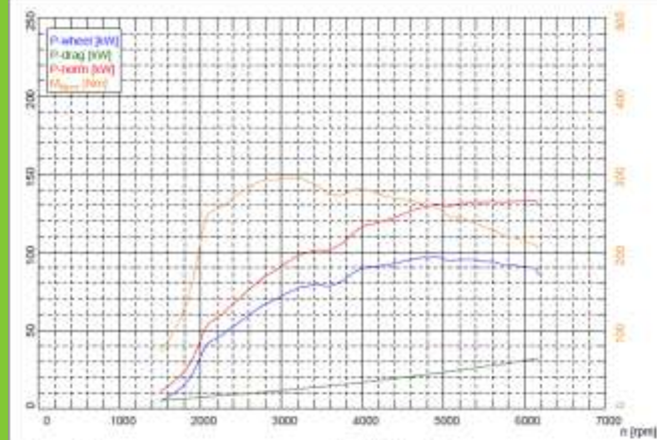
Test results for E10, RON 100



Power data						
Corrected power ¹⁾	P_{Norm}	130,4	kW	/ 177,3	BHP
Engine power	P_{Eng}	119,9	kW	/ 163,1	BHP
Wheel power	P_{Wheel}	93,1	kW	/ 126,6	BHP
Drag power	P_{Drag}	26,8	kW	/ 36,4	BHP
Max. power at		5295	rpm	/ 171,6	km/h
Torque ¹⁾	M_{Norm}	316,4	Nm		
Max. Torque at		2755	rpm	/ 89,4	km/h
Max. attained RPM		6110	rpm	/ 194,3	km/h

¹⁾ Correction acc. to ISO 1585
Correction factors: Q_y = 0,00 %

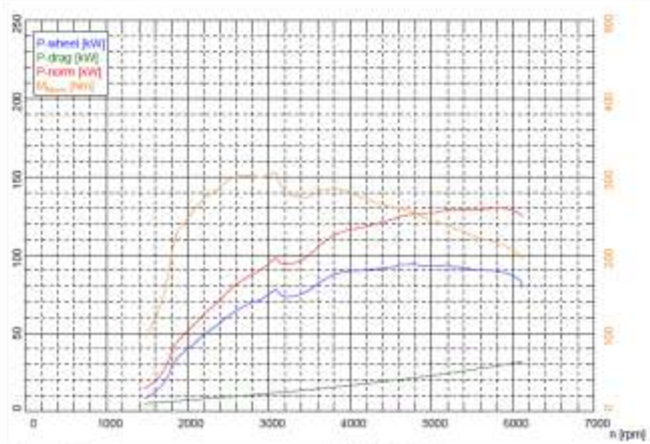
Ambient data			
Ambient temperature	$T_{Ambient}$	22,6	°C
Intake air temperature	$T_{Intake\ air}$	21,4	°C
Relative humidity	H_{Air}	71,1	%
Air pressure	p_{Air}	937,3	hPa
Steam pressure	p_{Steam}	19,5	hPa
Oil temperature	T_{Oil}	101,0	°C
Fuel temperature	T_{Fuel}	---,-	°C



Power data					
Corrected power ¹⁾	P_{Norm}	133,0	kW	/ 180,8	BHP
Engine power	P_{Eng}	121,8	kW	/ 165,6	BHP
Wheel power	P_{Wheel}	90,1	kW	/ 122,5	BHP
Drag power	P_{Drag}	31,7	kW	/ 43,1	BHP
Max. power at		6030	rpm	/ 192,7	km/h
Torque ¹⁾	M_{Norm}	295,5	Nm		
Max. Torque at		3035	rpm	/ 96,9	km/h
Max. attained RPM		6170	rpm	/ 194,9	km/h

¹⁾ Correction acc. to ISO 1585
Correction factors: Q_y = 0,00 %

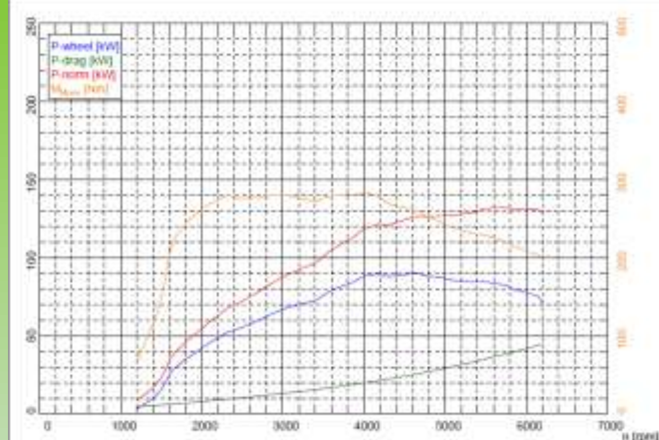
Ambient data			
Ambient temperature	$T_{Ambient}$	23,5	°C
Intake air temperature	$T_{Intake\ air}$	23,0	°C
Relative humidity	H_{Air}	70,2	%
Air pressure	p_{Air}	937,3	hPa
Steam pressure	p_{Steam}	20,3	hPa
Oil temperature	T_{Oil}	104,0	°C
Fuel temperature	T_{Fuel}	---,-	°C



Power data					
Corrected power ¹⁾	P_{Norm}	129,9	kW	/ 176,7	BHP
Engine power	P_{Eng}	118,7	kW	/ 161,4	BHP
Wheel power	P_{Wheel}	89,7	kW	/ 121,9	BHP
Drag power	P_{Drag}	29,0	kW	/ 39,5	BHP
Max. power at		5755	rpm	/ 184,7	km/h
Torque ¹⁾	M_{Norm}	300,0	Nm		
Max. Torque at		3045	rpm	/ 97,6	km/h
Max. attained RPM		6120	rpm	/ 195,0	km/h

¹⁾ Correction acc. to ISO 1585
Correction factors: Q_y = 0,00 %

Ambient data			
Ambient temperature	$T_{Ambient}$	24,3	°C
Intake air temperature	$T_{Intake\ air}$	23,6	°C
Relative humidity	H_{Air}	68,7	%
Air pressure	p_{Air}	937,3	hPa
Steam pressure	p_{Steam}	20,9	hPa
Oil temperature	T_{Oil}	114,0	°C
Fuel temperature	T_{Fuel}	---,-	°C



Power data					
Corrected power ¹⁾	P_{Norm}	132,2	kW	/ 179,8	BHP
Engine power	P_{Eng}	120,6	kW	/ 164,0	BHP
Wheel power	P_{Wheel}	82,9	kW	/ 112,7	BHP
Drag power	P_{Drag}	37,7	kW	/ 51,3	BHP
Max. power at		5685	rpm	/ 227,1	km/h
Torque ¹⁾	M_{Norm}	282,8	Nm		
Max. Torque at		3090	rpm	/ 159,2	km/h
Max. attained RPM		6180	rpm	/ 246,4	km/h

¹⁾ Correction acc. to ISO 1585
Correction factors: Q_y = 0,00 %

Ambient data			
Ambient temperature	$T_{Ambient}$	25,2	°C
Intake air temperature	$T_{Intake\ air}$	24,2	°C
Relative humidity	H_{Air}	67,4	%
Air pressure	p_{Air}	937,3	hPa
Steam pressure	p_{Steam}	21,6	hPa
Oil temperature	T_{Oil}	109,0	°C
Fuel temperature	T_{Fuel}	---,-	°C

In the speed range between 2000 and 3000 rpm the differences between the registered power values for the two types of E10 are insignificant, the curves overlapping almost on the entire interval. In this case a higher-octane level doesn’t increase the vehicle performance.

Only after the speed of 3600 rpm the power values become superior in the case of the 100 RON E10, in other words after this speed, the 100 RON E10 makes its presence felt. Between 3600 rpm and 6000 rpm the engine power level become superior, compared with the case of 95 RON E10.

The influence of ethanol concentration over the engine fuel consumption

The test engine and blends

For tests a port fuel injection gasoline engine was used. It’s a Renault 1.6-liter four inline cylinder engine, power 66 kW, at 5500 rpm, torque 128 Nm at 3000 rpm, code K7M 710.
The gasoline – ethanol blends used for tests were the following: E10 (95, 100 RON), E20 (95, 100 RON), E30 (95 RON), E100.
The full equipped engine was coupled to a hydrodynamic pin brake VEB – Shönebeck and the tests were performed for engine speed between 2000 and 3000 rpm at partial load.
In order to make the comparative analyses of fuel blends consumption, the hydrodynamic break load applied to engine for the entire range speed was 8 kgf, 78 N.

The gasoline – ethanol blends

Considering the gasoline – ethanol blends of different concentrations, for alcohol the mass fractions of its elements carbon, hydrogen and oxygen must first be defined. The same iteration must be applied for gasoline, too. Mass fractions formula is the following:

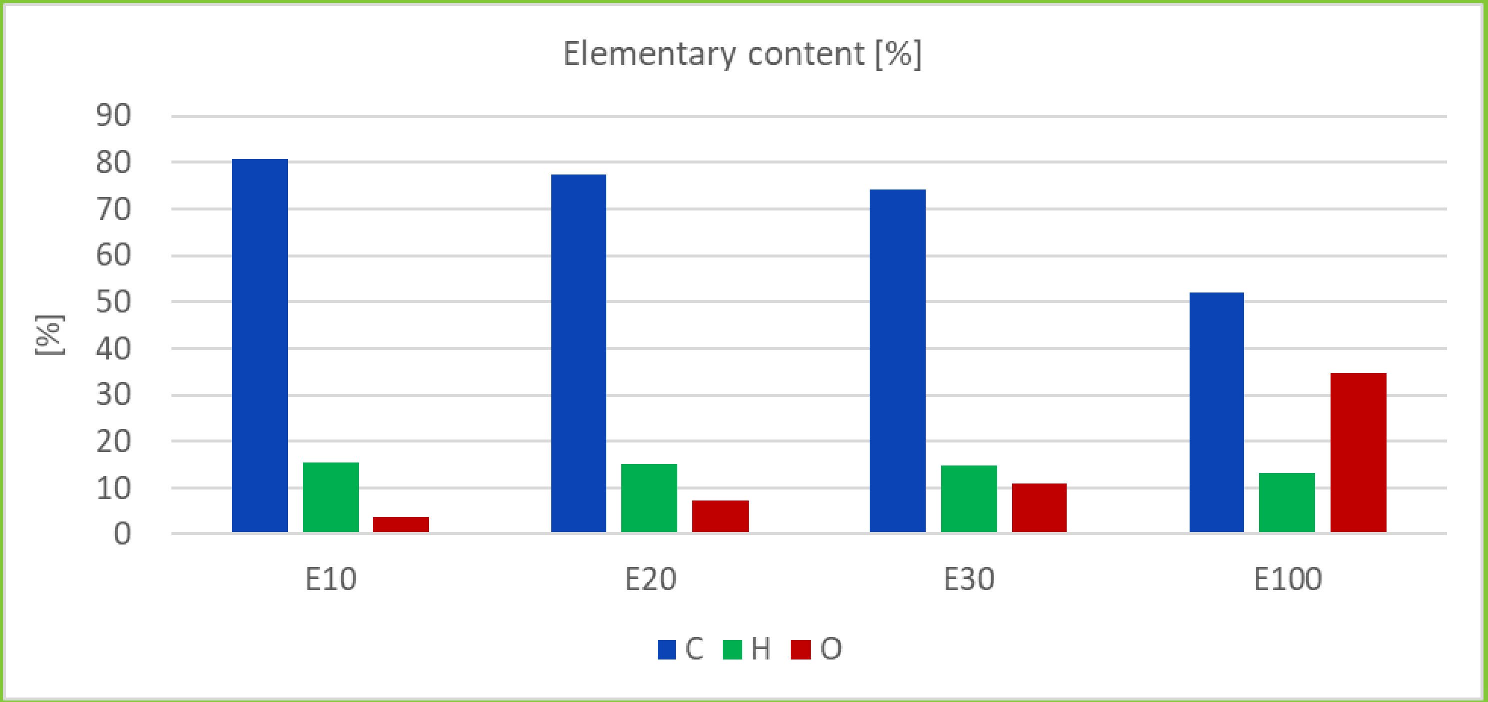
$$x_i = \frac{m_i}{\Sigma m_i}.$$

Molar mass and mass fractions for gasoline

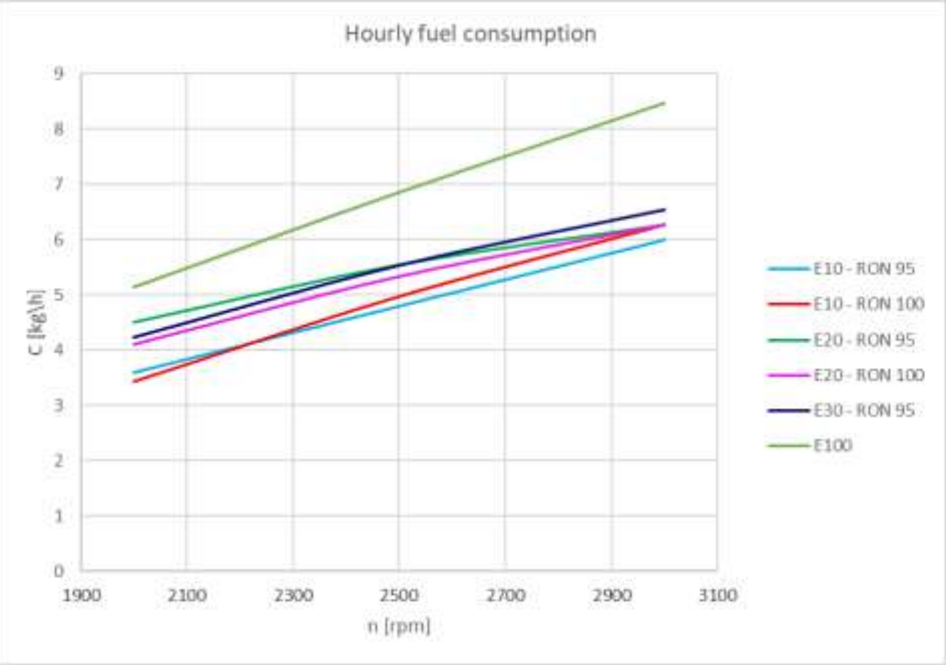
Gasoline	C_8H_{18}	Atom no.	Atomic mass	Mass	x_i
		-	[g]	[g/mol]	
	C	8	12	96	0.842
	H	18	1	18	0.158
$\sum m_i$				114	

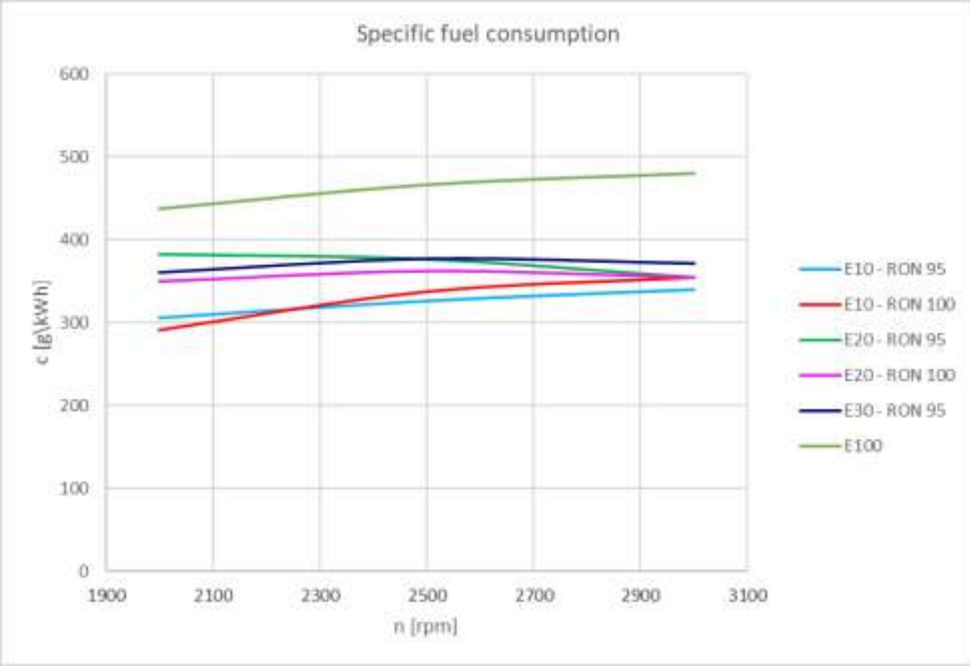
Molar mass and mass fractions for ethanol

Alcohol	C_2H_5OH	Atom no.	Atomic mass	Mass	x_i
		-	[g]	[g/mol]	
	C	2	12	24	0.5217
	H	6	1	6	0.1304
	O	1	16	16	0.3478
$\sum m_i$				46	

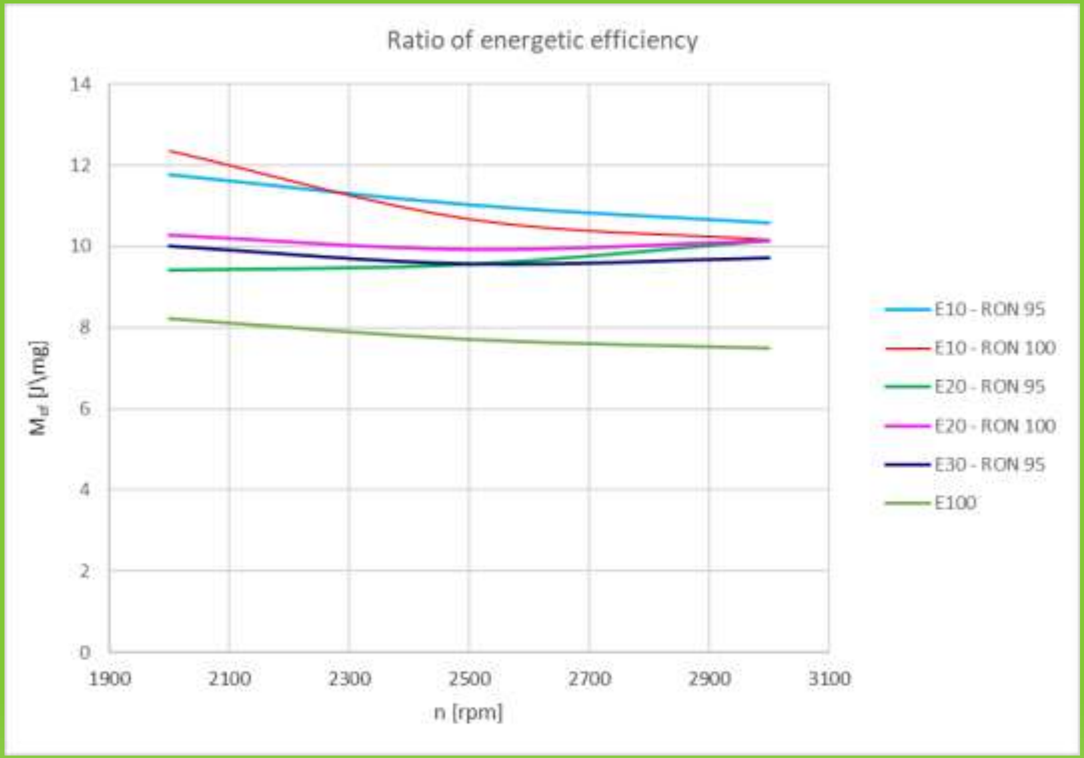


From the graph of variation of the elementary content of pure ethanol and of some gasoline ethanol blends it can be observed that the oxygen content increases correspondingly with the rise in the ethanol content in the mixture, reaching up to 35% in the case of E100. In contrast, the carbon content decreases with increasing ethanol content. These aspects highlight the low energy content of ethanol due to both the presence of oxygen and the reduction in carbon content. This aspect is also reflected in the lower calorific value that is decreasing with rising the ethanol content in the blend.





- ✓ the engine speed range and load were chosen specific to urban traffic conditions, where there are major challenges regarding the energy and ecological efficiency of engines;
- ✓ the best hourly fuel consumption values were obtained for E10 blends, poorest ones for E100, with slightly advantage above 2400 rpm for E10 RON 95 blend;
- ✓ the lowest values for specific fuel consumption resulted for E10 blends, especially for the RON 95 above 2300 rpm that indicates that engine mapping was optimized for gasoline with 95 octane rating;
- ✓ in order to maintain the same engine power output on tested speed range, fuel consumption increases in the case of superior ethanol participation percent in the blend.
- ✓ E100 (neat ethanol) represents a drawback by energetical point of view, functional optimizations of the engine maps being necessary and, depending on the results, constructive changes;



$$M_{ef} = \frac{L_{ef}}{q_{inj}}$$

ratio of energetic efficiency M_{ef} defined as ratio between effective mechanical work L_{ef} [J] and mass flow rate of injected fuel per cycle and cylinder q_{inj} [mg/cycle].

- ✓ by energetic efficiency ratio the same aspects are obvious, the most attractive option is E10 on a stock engine, without engine maps optimization;
- ✓ on current engines in order to increase efficiency functional optimizations are need in order to compensate the ethanol lack of energy density.

Researches regarding energetical and ecological performances of D.I. diesel engine fueled with biodiesel

Experimental research data

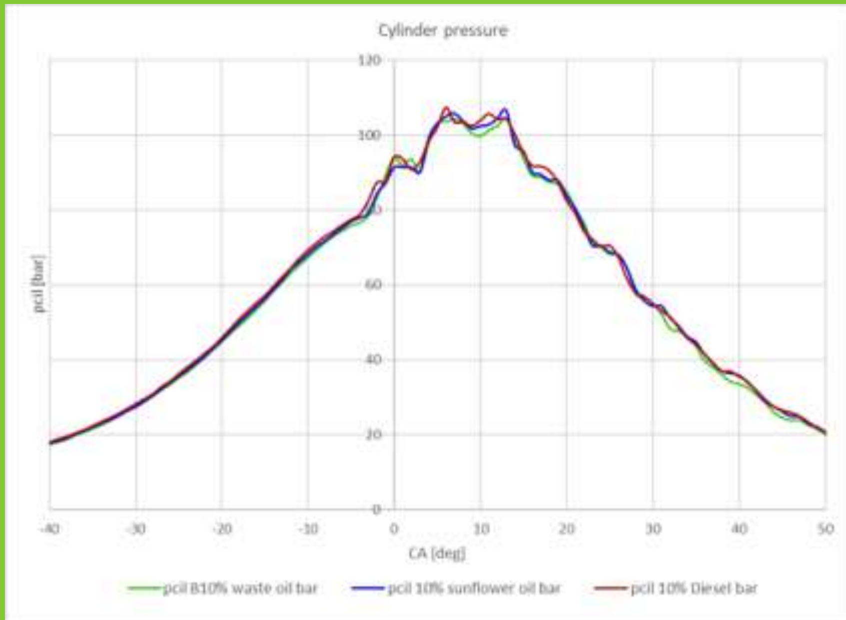
During the experimental phase, it was used pure petroleum diesel fuel and blended with biodiesel obtained from sunflower oil and waste oil. The proportion of biodiesel used during experiments was 10%.
Renault K9KP732 engine characteristics are the following:
- ✓ displacement: 1451 cm^3;
- ✓ bore x stroke: 76 x 80,5 mm;
- ✓ 4 inline cylinders, turbocharged;
- ✓ common rail direct injection;
- ✓ power: 78 kW / 4000 rpm;
- ✓ torque: 240 Nm / 2000 rpm.

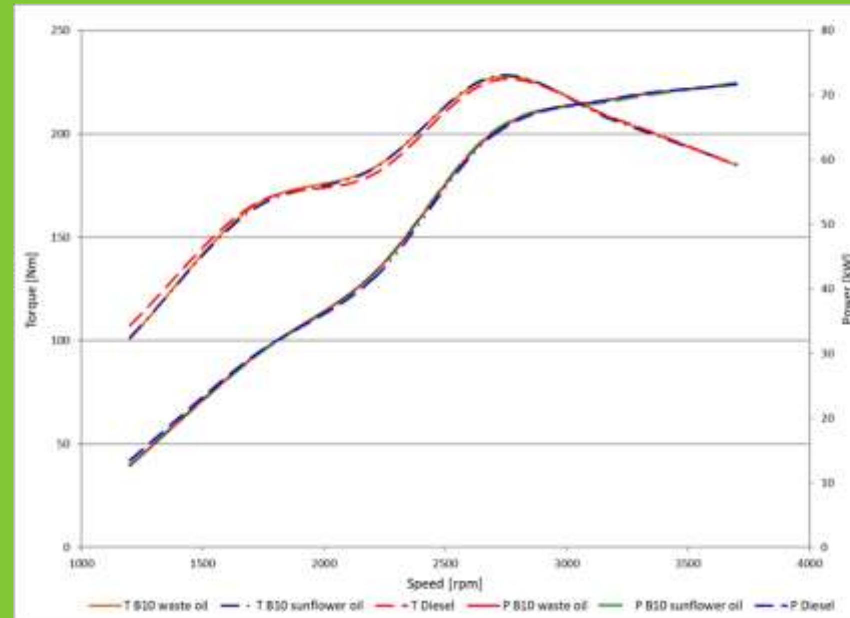
Experimental test bench is represented by a Horiba Titan T250 test stand that is optimized for steady state and transient testing of light and heavy-duty gasoline and diesel engines. The main characteristics of the Horiba Titan T250 test stand are:
- ✓ maximum torque: 400 Nm
- ✓ maximum speed: 8000 rpm
- ✓ moment of Inertia: > 0.3 kgm^2
- ✓ dynamometer: Dynas3 HT250
- ✓ response time: 4 ms
- ✓ maximum absorbed power: 250 kW

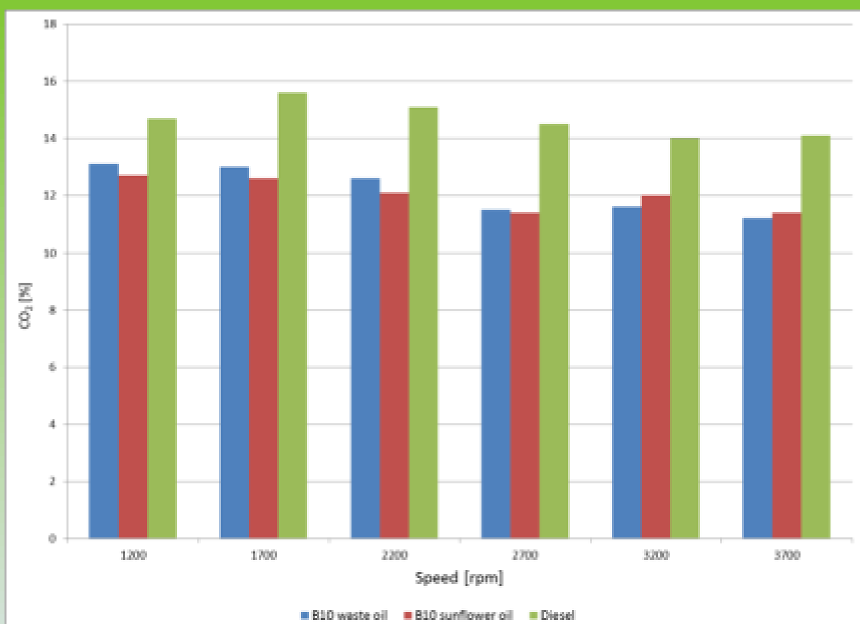
Horiba Titan T 250 stand, brake $DYNAS_3$

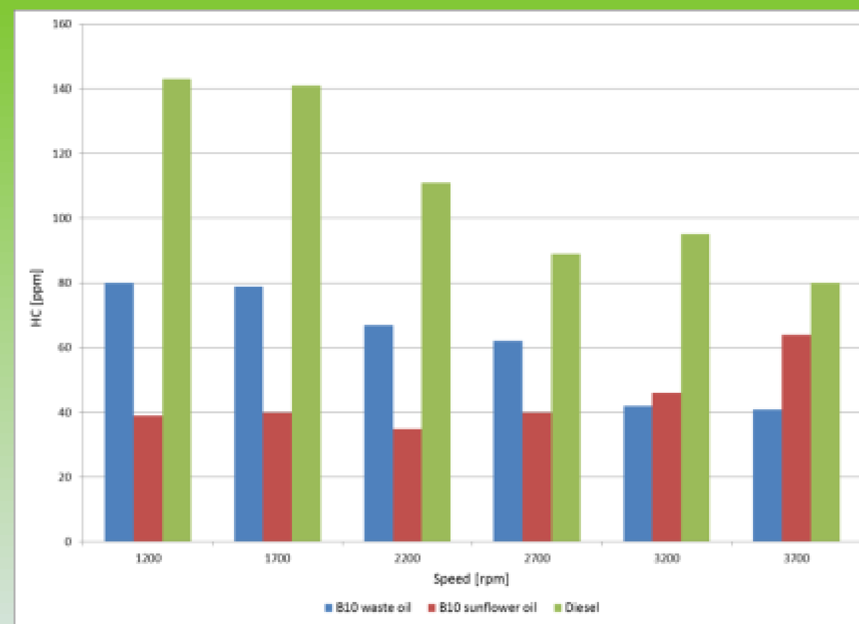
AVL 415S Smoke meter

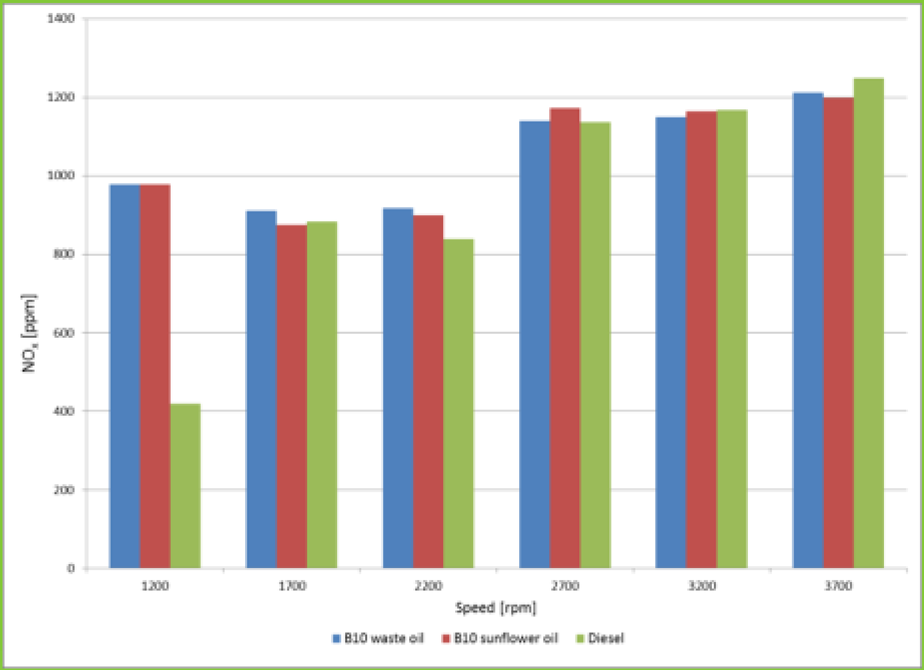
Pierburg HGA 400 analyzer

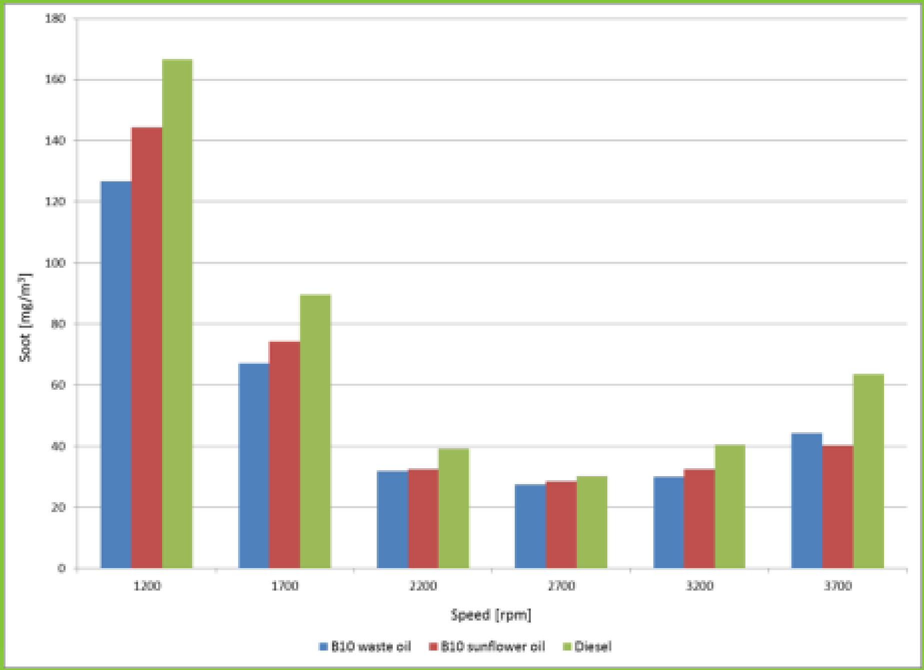

Cylinder pressure
pcil [bar]
CA [deg]
pcil B10% waste oil bar
pcil 10% sunflower oil bar
pcil 10% Diesel bar


Torque [Nm]
Power [kW]
Speed [rpm]
T B10 waste oil
T B10 sunflower oil
T Diesel
P B10 waste oil
P B10 sunflower oil
P Diesel


CO2 [%]
Speed [rpm]
B10 waste oil
B10 sunflower oil
Diesel


HC [ppm]
Speed [rpm]
B10 waste oil
B10 sunflower oil
Diesel





In terms of energetically performances, in case of B10 it can be observed that power and torque had an appropriate evolution, without notable differences compare to diesel fuel.

Regarding the ecological side, the usage of biodiesel blended with pure petroleum diesel fuel generally reduces most of emissions in compression ignition engines. The exception is represented by the NOx emission that is increased at some speed levels.

In conclusion it can be mentioned that B10 does not affect the energetically performance of the engine, while by the ecologically point of view, it generally represents an improvement.

Chapter 2. Influence of Road Infrastructure Design over the Traffic Accidents

Road accidents, their causes and effects represent a major problem for any country through medical, social and economic point of view.
The European Road Safety Observatory (ERSO) report, it reveals that Romania is characterized by one of the highest road accidents incidence in EU.
The implementation of a Safe Systems procedure to road safety, based on the following main elements:

- Human behavior, considering that no matter how well people are trained for a responsible road use, they can make mistakes and road infrastructure must be developed taking this aspect into account.
- Human frailty, consisting in limited resistance of the human body to various types of collisions, the assessment of the injury risk and the severity of injuries. It represents another design criterion.
- Forgiving systems meaning that any human error must not be potentiated by the road.

Contributing factors to road accidents can be grouped as follows:

- human factors
- road infrastructure factors
- environment and weather
- vehicle design and physical condition

The safe roads concept, in particular self-explaining roads involves an understandable one by the driver point of view, considering some important specific elements, such as: roadway quality in terms of adhesion and bumps free asphalt surface, day and night visibility, predictable road regardless of weather conditions, road markings and traffic signs, road sector optimal geometric configuration, etc. A high density of road signs or markings in complex traffic scenario may lead to an information overload and an increased risk of driving errors.

The unforgiving – forgiving roadside concept

A significant percent of fatal road accidents in the EU are single-vehicle type accidents, being classified as run-off-road accidents (vehicle leaves the carriageway and crashes to the roadside).
A roadside is called unforgiving if hazardous objects such as trees, poles are positioned too close to the road, increasing the chance of serious collisions. The purpose of the 'forgiving roadside' concept is to avoid crashes of drifting vehicles with potential hazards or to minimize accidents consequences.
The forgiving roads concept assumes driving errors consequences minimization, rather than preventing them.
Having this principle as a guideline, the entire road infrastructure must comply with the following:

- Minimize the risk of vehicle leaving the carriageway by using vehicle active systems (e.g. line assist), correlated with appropriate road delineation;
- Provide an adequate stopping distances or recovery area, when a car run-off the road;

If a collision still occurs with any roadside obstacles, it is mandatory that impact forces transmitted to the vehicle occupants to be at minor levels (no fatal or serious injury outcomes).

Roadside hazards

Roadside hazards can be grouped as follows:

- ✓ single fixed obstacles (e.g. trees, vegetation, utility poles, road signs, safety barrier terminations, rocks, drainage features, etc.);
- ✓ continuous hazards (e.g. ditches, slopes, road restraint systems, kerbs, etc.);
- ✓ dynamic roadside hazards (e.g. pedestrian and bicycle facilities, parking).

A. Single fixed obstacles

Examples of hazardous trees located on the roadside

Examples of utility poles that located on the roadside

Examples of hazardous bridge abutment and walls

Examples of hazardous safety barriers ends

Examples of hazardous rocks and boulders

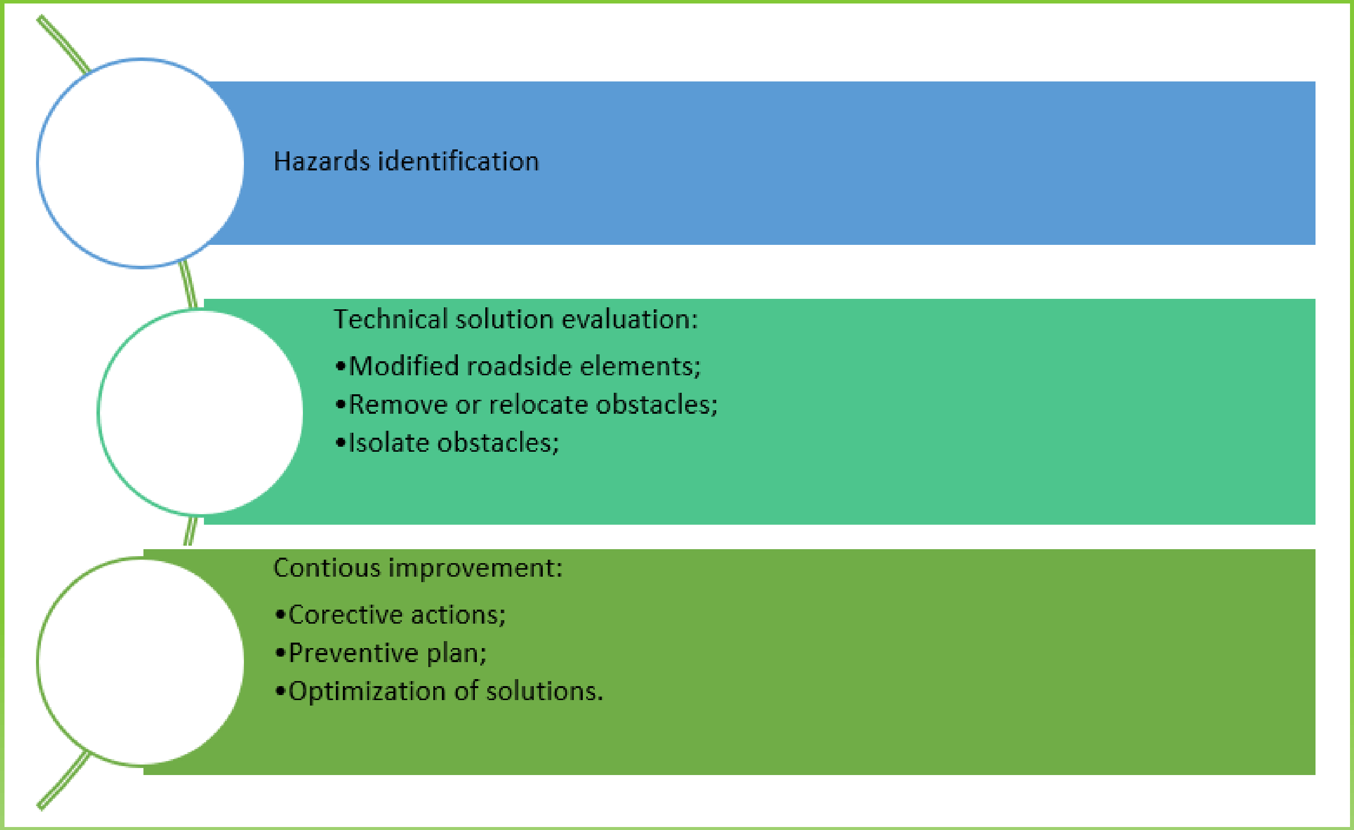
B. Continuous hazards

Examples of hazardous roadside ditches

Examples of collisions with safety barriers

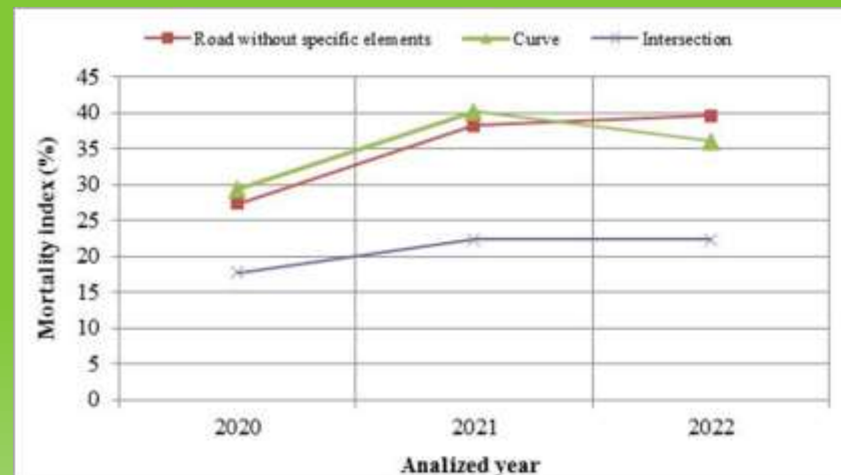
Unprotected terminals

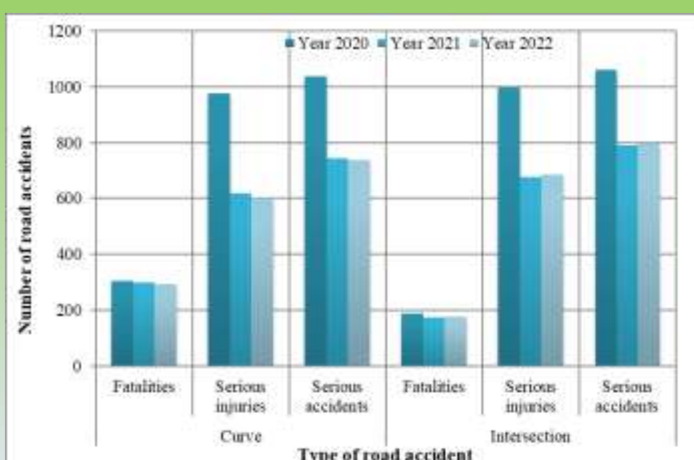
Forgiving roadside solutions procedure



The study scope and background

The study's goal is to investigate the effect of the unforgiving roadsides on European route E68 (DN1) in Romania, over the degree of vehicle passenger's injury, respectively the level of car damage, having as a base point specific accidents produced on the road sector between the cities Brașov and Făgăraș, in Brașov county.

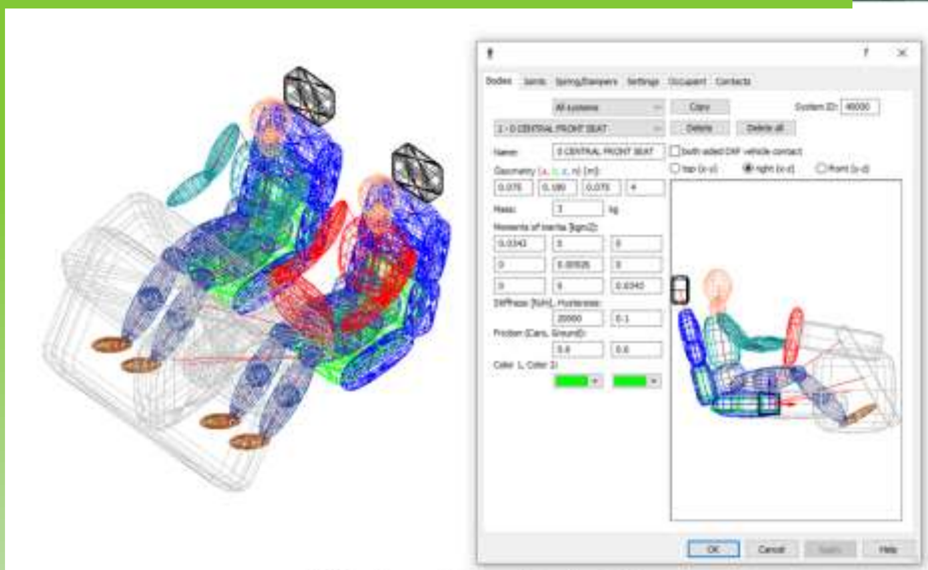




E68 (DN1) – curved road sector used for the study.

Accident simulation scenario

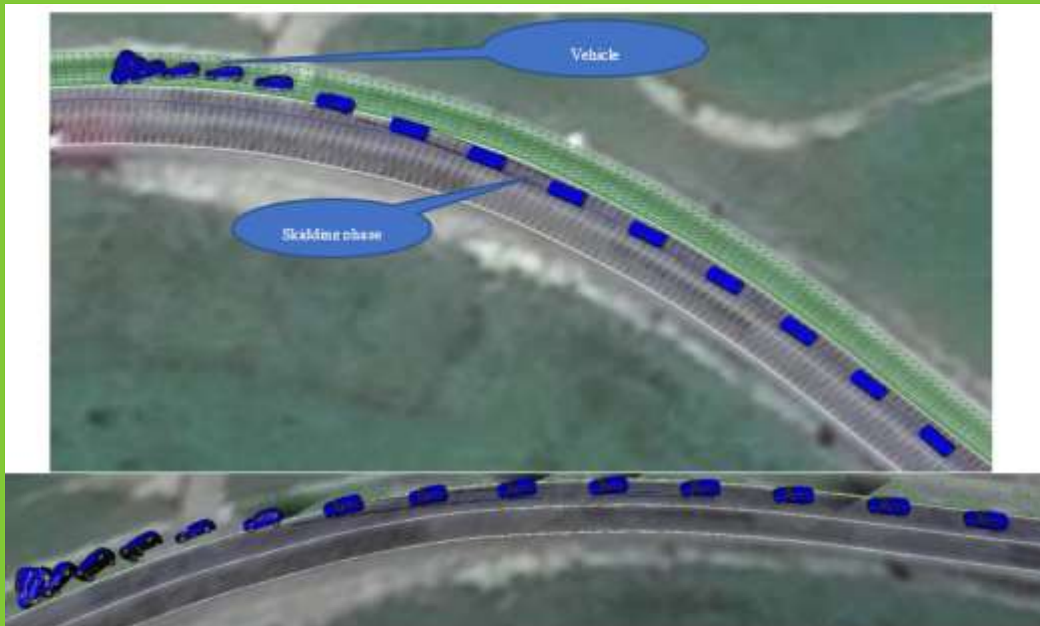
Simulation scene, ditch profile – E68 (DN1).



Multibody model used in simulation.

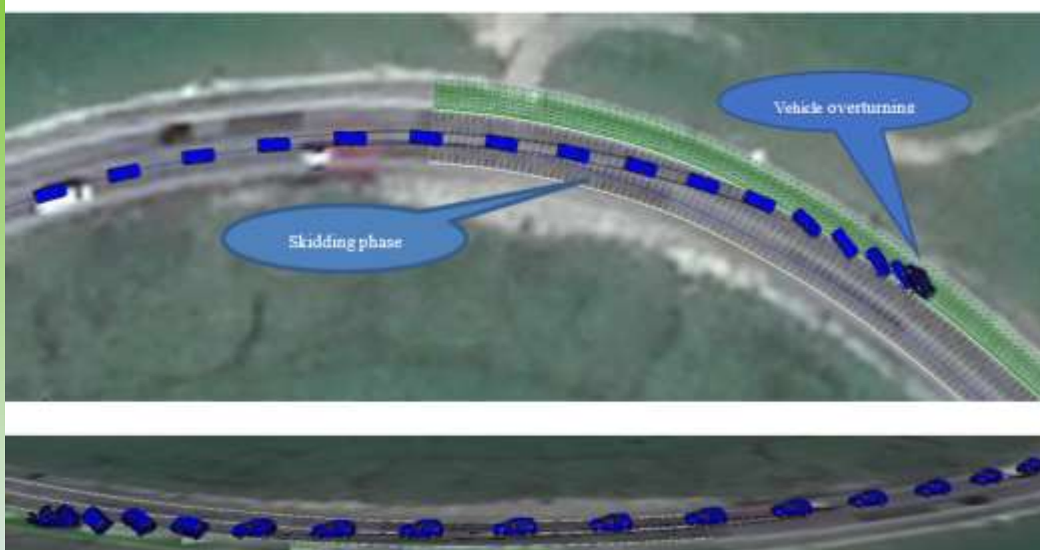
Vehicle type	**SUV, 4WD**
Vehicle speed before entering the curve	90 km/h, case a) & b)
Friction coefficient, wet conditions	0.5
Maximum deceleration, wet conditions	4.91 m/s^2
Multibody model	2 front belted occupants: 80 kg, 1.8 m height each

Simulation results



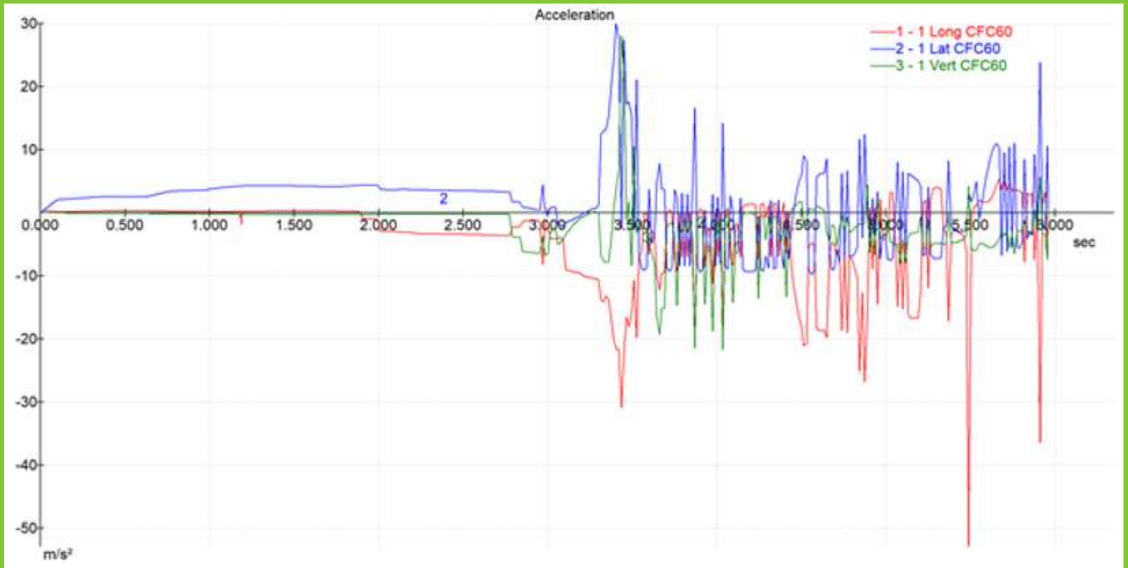
Consecutive simulation sequences at time intervals of 0.4 s – case a)

Vehicle speed – case a).



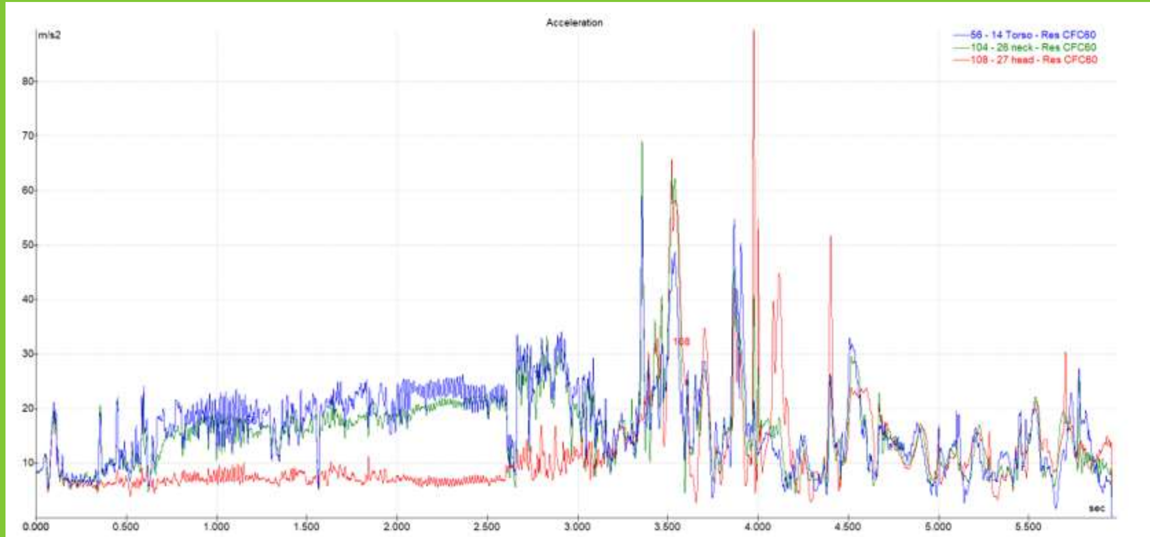
Consecutive simulation sequences at time intervals of 0.4 s – case b).

Vehicle speed – case b).

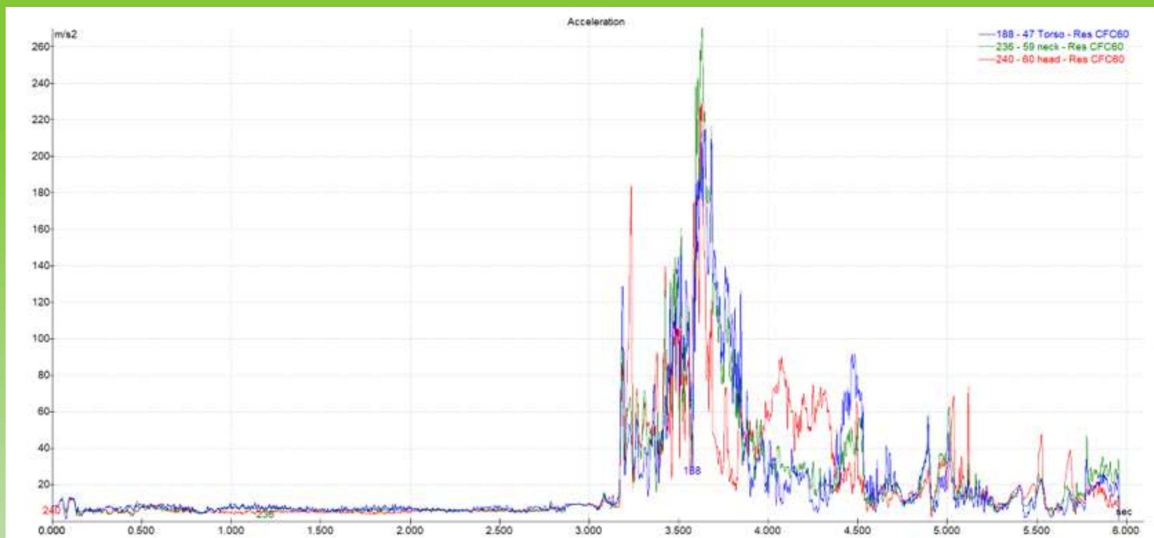


Vehicle acceleration – case a).

Vehicle acceleration – case b).

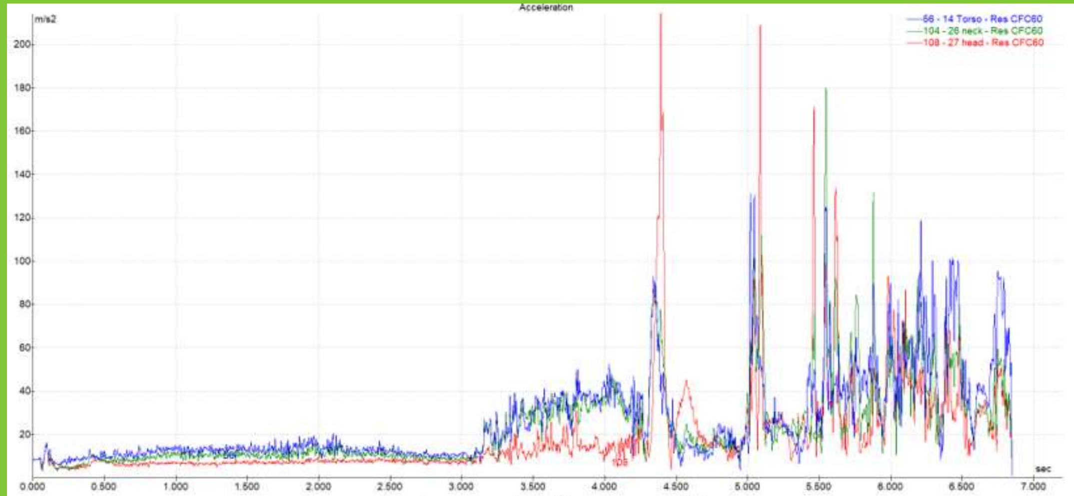


Driver acceleration – case a).

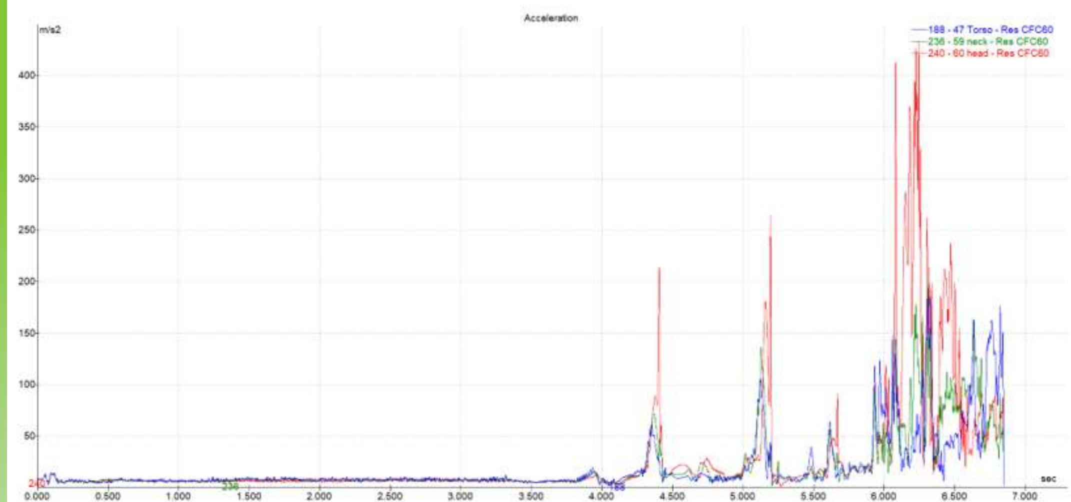


Front right-side occupant acceleration – case a).

In case a) the maximum obtained value of head acceleration (right-side occupant) was about 240 m/s^2, 24 g, that correspond to HIC15 <130 inducing to the occupant no concussion, eventually a headache or dizziness, with effects for less than an hour.

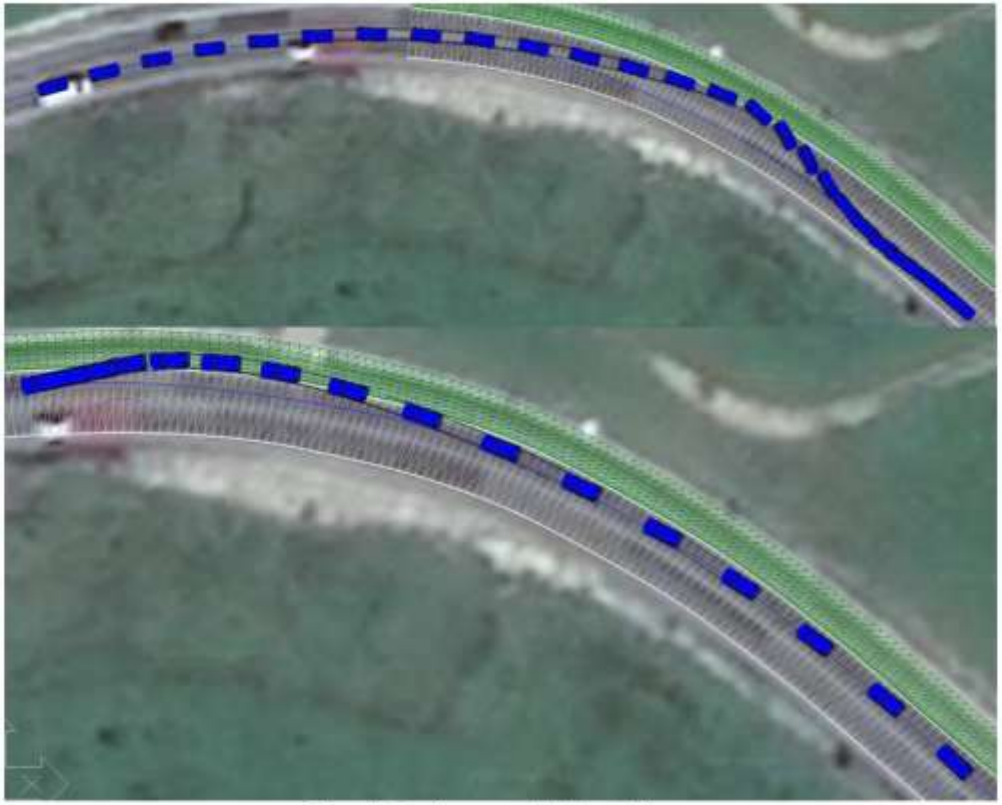


Driver acceleration – case b).



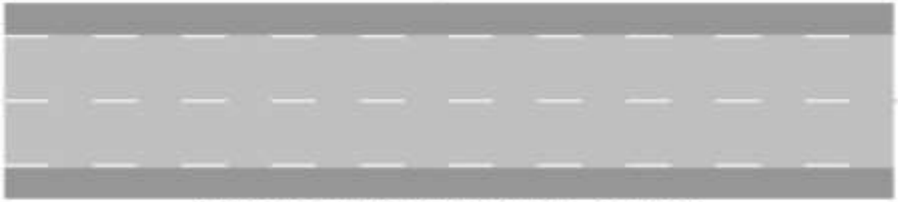
Front right-side occupant acceleration – case b).

In b) case the maximum value obtained for the acceleration for the driver's head was about 210 m/s^2, that correspond to HIC15 <130 inducing to the driver no concussion, eventually a headache or dizziness, with effects for less than an hour. The maximum value for acceleration for the right-side occupant was about 412 m/s^2, 41 g, value that corresponding to HIC15 180, the occupant suffering mild concussion.



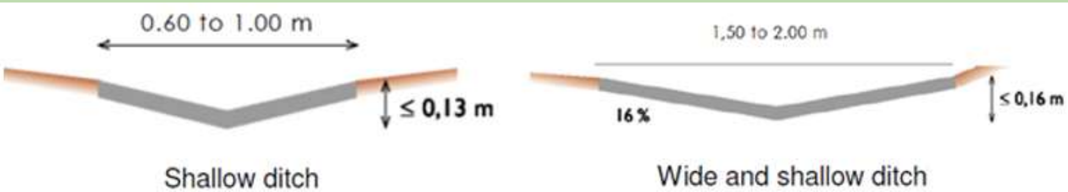
The effect of covered ditch solution.

Rolling barrier.



Enlarge and pave the road side shoulder – safety zone.

Crashworthy terminals



Examples of safe ditch.

Chapter 3. The Influence of Laser Micro-Perforation Parameters over the Airbag Processing and on the Efficiency and Passengers' Safety during an Impact

In the automotive industry, passenger safety is a top priority. The airbag is one of the most critical components of passive safety systems, designed to protect passengers during a collision. A crucial aspect in the design and manufacturing of dashboards and other interior surfaces of vehicles is the compatibility of these components with the airbag system. In this context, laser perforation plays a vital role in ensuring the proper functioning of the airbag and its efficiency.

Synthetic leather and other finishing materials used on the dashboard and vehicle interiors are created not only for aesthetics but also to meet technical safety requirements. One such requirement is the perforation regime, which is essential to allow the airbag to deploy optimally in the event of an impact.

Laser Micro-Perforation Regime

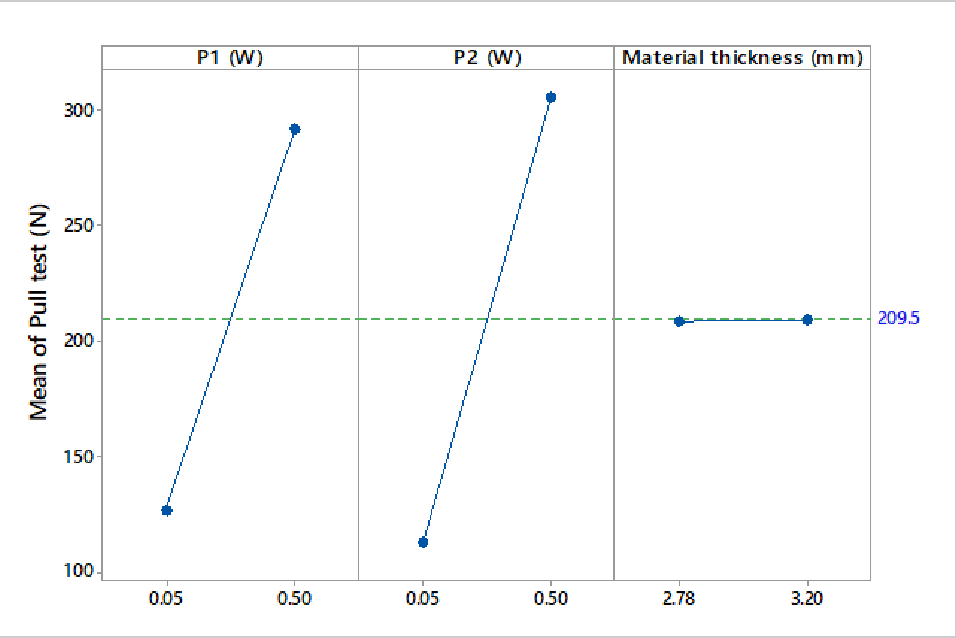
Laser perforation is a process in which materials, including synthetic leather, are perforated with tiny holes using a high-precision laser. This technique is used to weaken the material in a controlled manner, allowing the airbag to penetrate the dashboard surface without compromising the aesthetic or structural integrity of the dashboard. In the area where the passenger airbag is mounted, a discreet weakening of the material is necessary to ensure the airbag can break through the surface without delays or blockages.

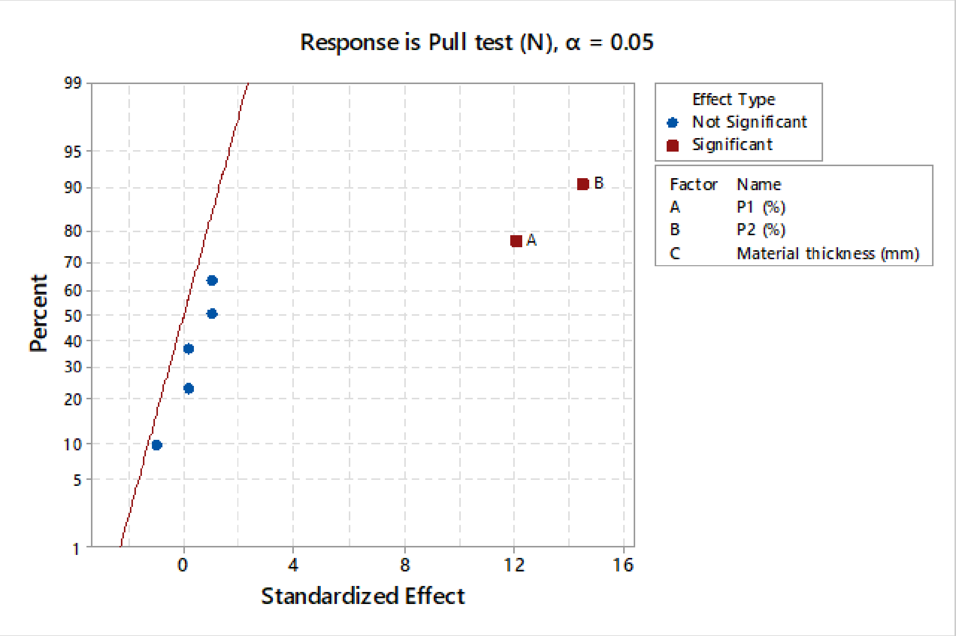
The laser perforation regime involves setting critical technical parameters, such as hole size and density, cut depth, and the distance between holes. These parameters must be carefully adjusted to balance aesthetics, material strength, and efficient airbag deployment.

The Role of Micro-Perforation of Airbag from the Passenger' Zone

Laser micro-perforation of airbags from the passenger' airbag zone has a significant impact on how the airbag opens during an impact. Without proper micro-perforation, the dashboard's covering material, such as synthetic leather, can delay or impede the airbag's deployment, which could compromise passenger safety. If the dashboard is manufactured without this predefined weakening, the airbag may encounter more mechanical resistance, leading to a critical delay in full deployment.

A well-designed micro-perforation regime allows the airbag to break through the dashboard material almost instantaneously, ensuring effective passenger protection. Laser micro-perforation creates a controlled break point, making the material yield predictably and release the airbag without significant resistance. This is essential because a delayed or incomplete opening can severely affect safety during an accident.



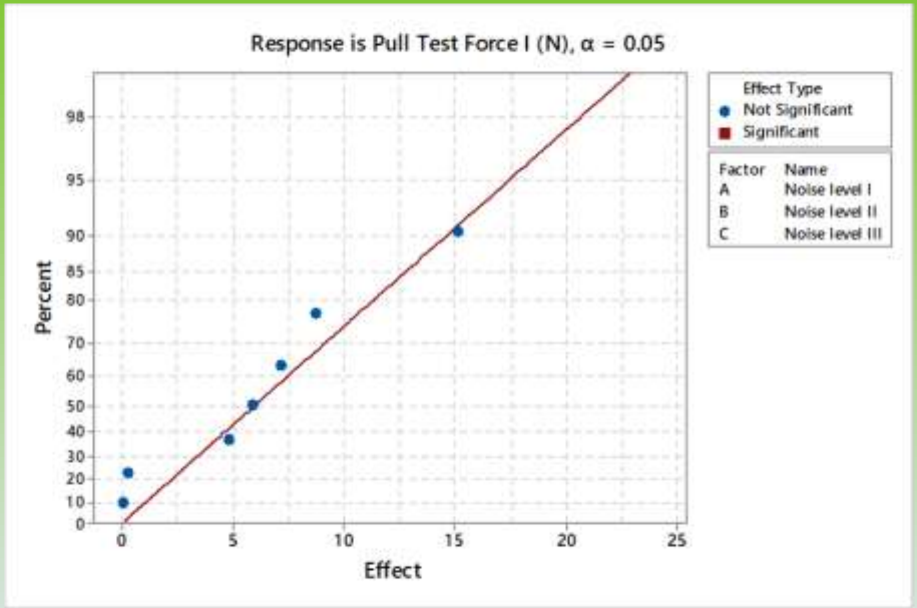


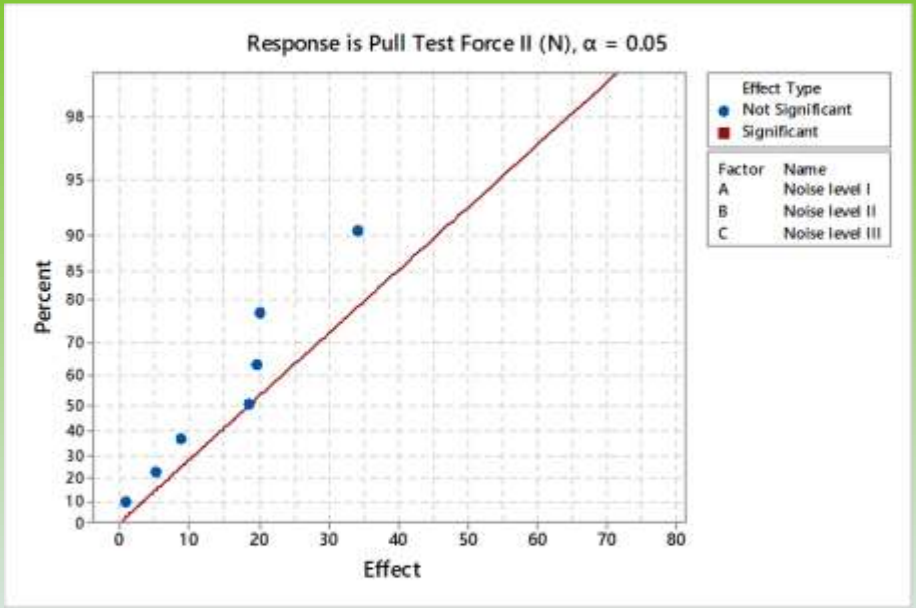
Micro-perforation factor effects.

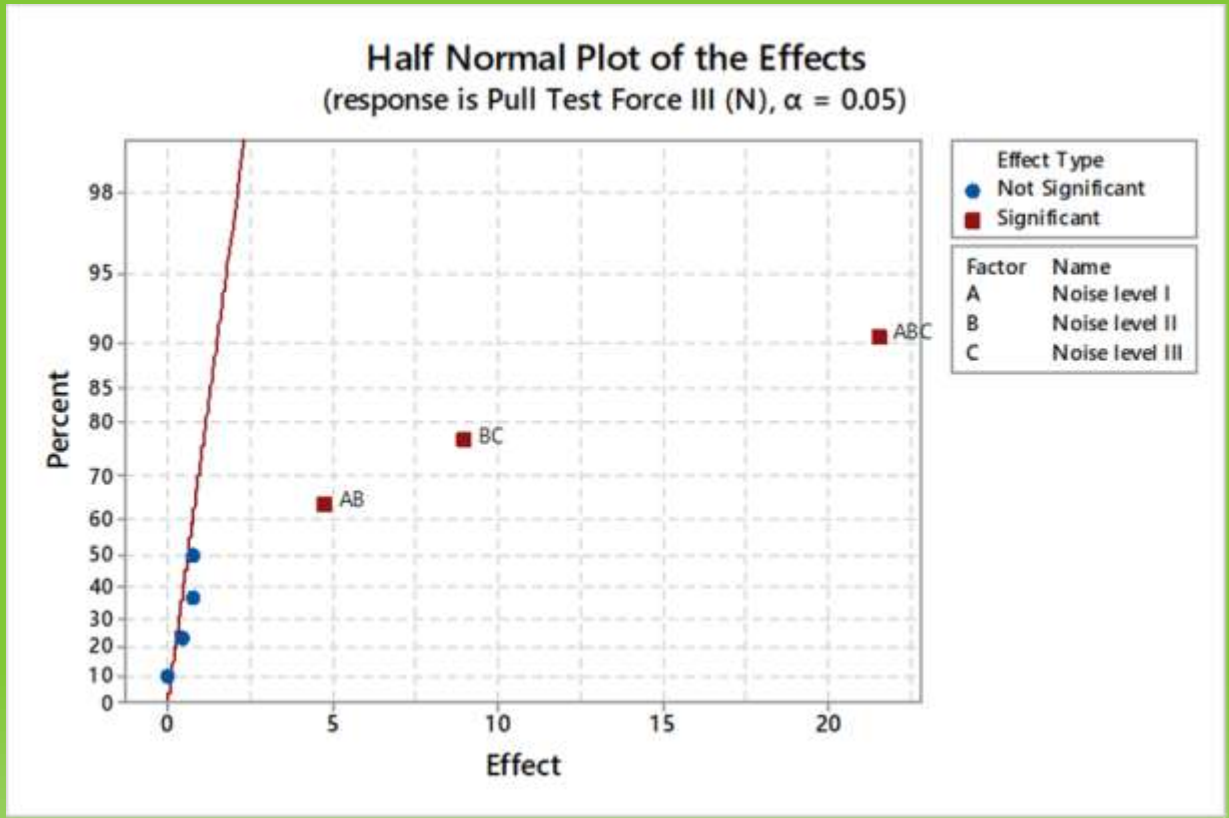
The electromagnetic noise level influence during the laser micro-perforation process

This study aims to investigate the critical parameters and effects of generated noise (energy) during the laser micro-perforation process of synthetic leather airbag components. Noise in the context of laser processing refers to the unwanted energy variations that can affect the stability and precision of the laser beam. Such variations can lead to inconsistencies in perforation size, shape, and edge quality, all of which are critical parameters for maintaining the functionality and safety of airbags.

In order to highlight the interaction between the electromagnetic noise levels, material thicknesses, pull test results and its effect on the micro-perforation process, the effects charts was plotted.







In the automotive industry, the precision and quality of components are essential for the performance and safety of vehicles. One of the modern processes that significantly contribute to achieving these high standards is laser micro-perforation. This technology allows for the creation of fine and precise perforations, used in various applications.

The main advantages refer to: precision, production and speed of processing, customizations and effects of processing, security performance, waste reduction, the decrease in non-quality costs, etc.

In the domain of the manufacture of automotive parts, the laser technology is clean and precis. The laser process surpasses the capabilities of many traditional cutting methods, characterized by extreme accuracy and the capability to achieve high precision.

Academic career development

A. In the targeted habilitation domain

- an essential aspect of the further evolution of the academic career is related to doctoral supervisor in the field of Automotive engineering;
- collaboration between the academic zone with industry field through doctoral students, in order to identify and develop topics that meet current developments and future innovation requirements;
- innovation, interdisciplinarity, partnership, technology transfer, training and continuing education represent my main strategy with clear objectives that I want to pursue after obtaining my habilitation certificate in order to coordinate doctoral students;
- emerging ideas and technologies, which are just at the beginning in academia, can become successful technologies in the market through investment and practical application in industry;
- publishing articles in internationally recognized specialized journals, indexed by WOS with impact factor, but also by presenting at international scientific conferences with increased visibility in academic and research environments;
- in the category of important proposed objectives regarding the activity with the future PhD students, it must be mentioned the realization of new scientific research projects, followed by the valorization of the results that contribute to the development of knowledge in the specific field.

B. Scientific and research field

- Scientific activity contains two directions that complement each other, namely: the research activity itself and the dissemination - publication, patenting of the results of the research carried out;
- The scientific and research activity development primarily will follow the main directions summarized in the present habilitation thesis;
- Pursuing the expansion of the field of competences into an interdisciplinary one is welcome, and can be achieved by establishing collaborations with other universities and research institutes, through the involvement of PhD students and students, especially those from master's programs.
- By involving master's students, the premises are created for their familiarization with the research area and implicitly the desire to continue their professional development in the doctoral study cycle may arise.
- I want to attract funds through grant proposals / scientific research projects with national and international funding.
- Experimental and innovative research involves maintaining and expanding collaboration with the industrial economic environment,
- International visibility will be supported by the annual publication of scientific articles in WOS indexed journals with impact factor, as well as articles indexed in WOS proceeding, international databases or at prestigious national and international conferences. The results of future scientific research will also be found in specialized books.
- To increase the visibility of my research results at national and international level, will also be achieved through participation in prestigious international scientific congresses and conferences whose papers are indexed by WOS or SCOPUS.

C. Didactic activity

The main directions in the development of the university teaching career will aim the following:

- ✓ promoting a teacher-student partnership so that students' needs are correctly identified;
- ✓ didactic activity focused on interactive courses in which students actively participate, as well as their involvement in solving case studies, projects and practical applications in the field of automotive engineering;
- ✓ implementing modern teaching-learning techniques and methods, in order to ensure professional training in line with practical realities from the industrial field;
- ✓ continuous adaptation of master degree program "Motor vehicles and Future Technologies" that I am coordinating to the dynamics of the automotive industry and implicitly to its requirements;
- ✓ permanent updating of the teaching materials content of the subjects taught, in order to ensure the consistency between their content and the objectives of the specializations, as well as adaptation to the real needs of the labor market;
- ✓ involvement in the modernization and laboratories endowment, in order to ensure optimal practical support for the taught disciplines;
- ✓ introducing new disciplines in accordance with the requirements of the educational market and students;
- ✓ permanent development and expansion of partnerships with the socio-economic environment in order to facilitate interaction between potential employers and students;

Thank you for your attention!