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# THE IMPACT OF DIFFERENT INJECTION SYSTEM PARAMETERS, ON THE GEOMETRICAL FEATURES OF THE DIESEL SPRAY JET

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***Abstract:*** *Fuel spray geometrical features as: penetration, cone angle, spray elevation angle, of Diesel engines, have significant impact on pollutant emission formation. Therefore, it is necessary to investigate how the fuel spray geometrical features are being developed under the influence of different injection parameters variation.*
*The paper presents some experimental researches and studies in the domain of Diesel internal combustion engines, with emphasis on fuel spray geometrical features.*
*Are presented information concerning fuel spray tip penetration, spray cone angle, spray elevation angle, and how they are influenced by injection pressure, injected quantity and in cylinder back pressure.*
*Researches was done, using the latest testing tools as Moehwald CI 4000, and spray bomb vessel with high speed camera of 15000pps resolution.*
***Keywords:*** *Diesel engine, Injection, Fuel Spray, Injected quantity, Injection pressure.*

## 1. INTRODUCTION

Improving pollutant emission and engine performances of Diesel engine, needs better understanding of air-fuel mixing procedure. One of the most important parameter which is related to the mixture process is the geometrical features of the fuel jet. The purpose of this study is to determine the impact of different injection system parameters, as: rail pressure, back pressure, injected fuel quantity, on the macroscopic features of the fuel jet.

## 2. EXPERIMENTAL SET-UP

### 2.1. Experimental facilities

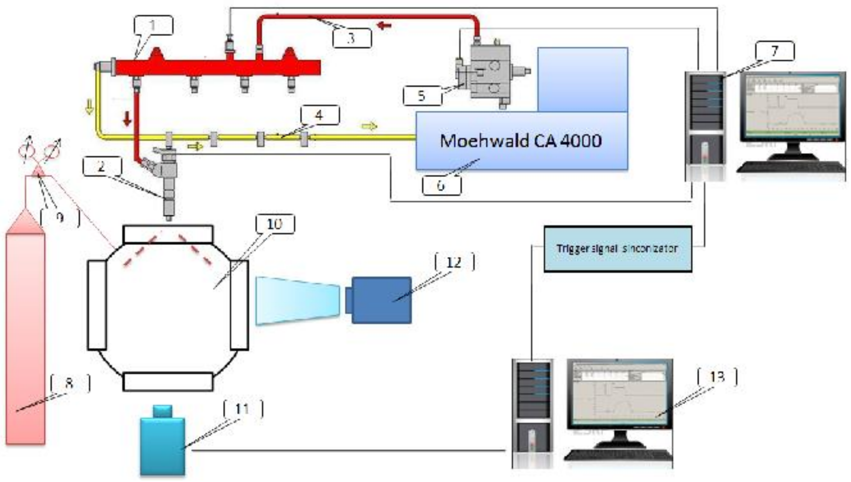


**Figure 1:** Facilities for optical investigation of fuel jet

1- Common rail
2- Injector
3- High pressure pipe
4- Pipe
5-High pressure pump
6- Moehwald CA 4000
7- Injection system control PC
8- Nitrogen high pressure tube
9- Pressure regulator
10- High pressure vessel for spray fuel jet optical investigation
11- Reflector
12- High speed camera
13- Camera control PC.

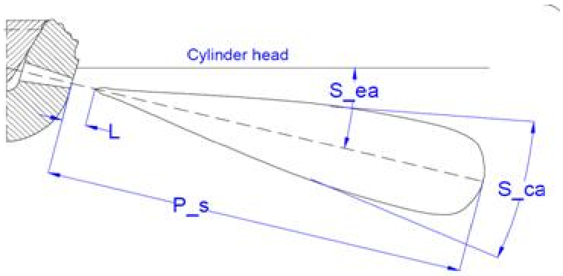


**Figure 2:** Fuel jet geometrical features

In order to investigate the macroscopic features of fuel jet, it is necessary to define these features. In the Fig. 2, it is shown the spray tip penetration "P_s", the spray elevation angle "S_ea", and the spray cone angle "S_ca". This are the most important macroscopic features of the fuel jet.
The symmetry of fuel jets, and the Sauter Mean Diameter, are also, features, which have a strong impact on air-fuel mixture, but there are not investigated in this paper.

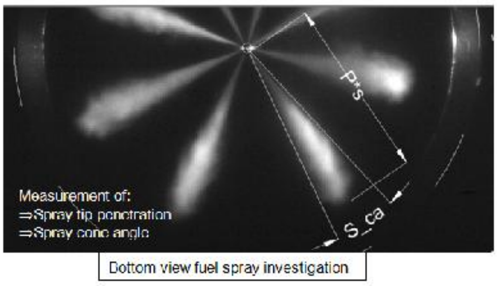


**Figure 3:** Analyzing fuel jet with AutoCad

In order to investigate the macroscopic features of fuel jet, it is necessary to drive a "Common rail injection system", and control it. This is possible, if it is used a Moehwald CA4000 injection test bench [1]. The test bench offers the possibility to modify the injection pressure, but also, the fuel injected quantity, driving with different timing of injector solenoid. All the command will send to the actuators, via PC no.7.

Important equipment is the optical module for analyzing the fuel jet features. This has a high pressure vessel, which can simulate the in cylinder condition, but without any temperature variation. In this vessel, the injector is injecting the fuel, and the shape of the jet, can be analyze, using the high speed camera. The captured picture was analyzed, using AutoCad software (Fig.3).

### 2.2 Test matrix

In order to fulfill our purpose, it was build a test matrix, were it is describe the variation of: rail pressure, injected quantity, and different back pressure, which simulates the in cylinder condition. This can be adjust by using the device 8 an 9 from Fig.1.

**Table 1:** Test matrix

| Rail Pressure (bar) | Injection Quantity (mg/stroke) 0.25 | 0.5 | 0.75 | 1 | 1.5 | 3 | 5 | 15 | 30 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|
| 250 | x | x | x | - | - | x | x | - | - | - |
| 500 | x | x | x | x | x | x | x | x | | |
| 750 | x | x | x | x | x | x | x | x | - | - |
| 1000 | - | x | x | x | x | x | x | x | x | x |
| 1250 | - | x | x | x | x | | - | x | x | x |
| 1500 | - | - | - | x | x | - | - | - | x | x |

Purpose:
P_s, S_ca, S_sym=f(Q_inj)
P_s, S_ca, S_sym=f(P_Rail)

The impact of Back Pressure (P_Back), was done using only the basic nozzle.
Test condition: P Back= 10bar / 20bar/ 30bar → S_ea, P_s, S_ca, S_sym=f(P_Back)

## 3. RESULTS

The next figures will show the optical fuel spray investigation results:

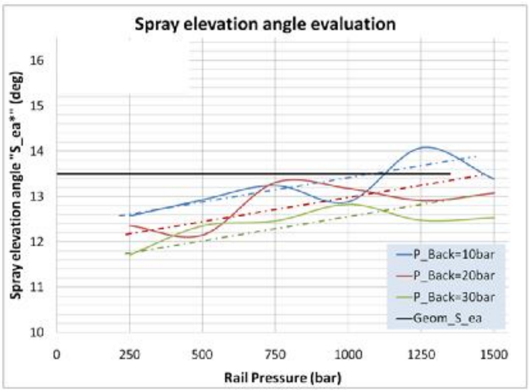


**Figure 4:** Impact of P_Back and P_rail on "S_ea*"

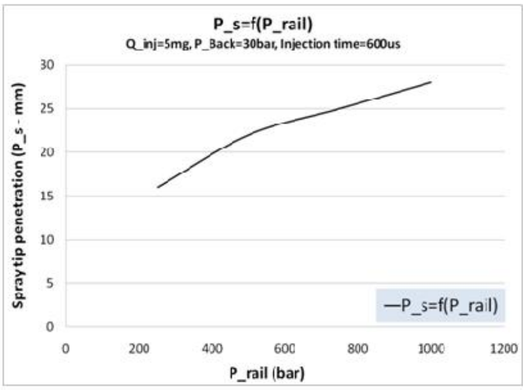


**Figure 5:** Impact of P_Rail on spray penetration

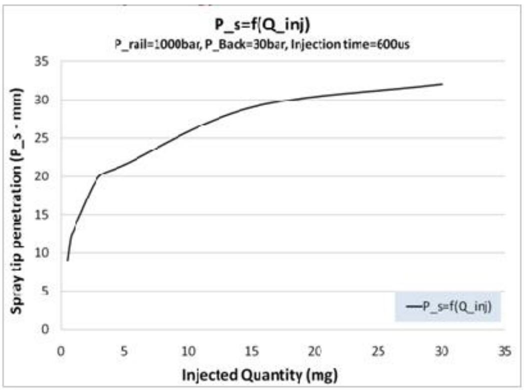


**Figure 6:** Impact of Q_inj on Spray penetration

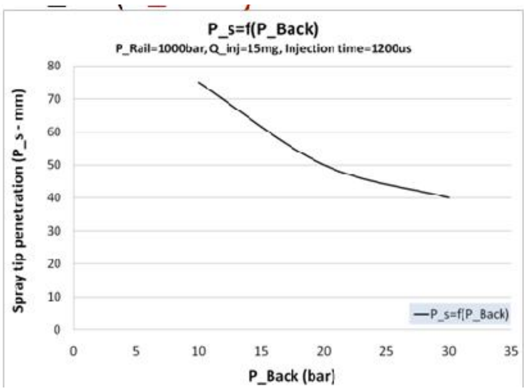


**Figure 7:** Impact of back pressure on spray penetration

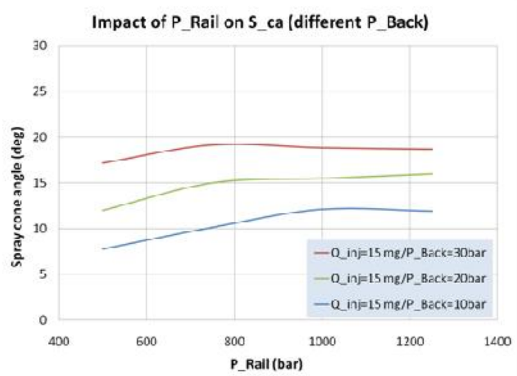


**Figure 8:** Impact of P_rail & Q_inj(cst) on S_ca

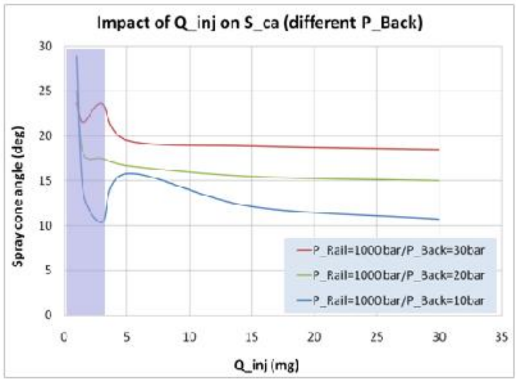


**Figure 9:** Impact of Q_inj & P_rail (cst) on S_ca

## 4. CONCLUSION

- Increasing rail pressure, the dynamic spray elevation angle will increase, but only on high injection pressures, will reach the same value as the geometrical one. (Fig. 4)
- Higher back pressure will decrease the Spray elevation angle (Fig. 4)
- Increasing the rail pressure, the spray tip penetration will increase (Fig. 5)
- If we are going to use higher fuel injected quantity, the spray penetration will increase. (Fig. 6)
- Higher in cylinder back pressure, will lead to less spray tip penetration (Fig. 7)
- Analyzing a complex chart, were there are shown results on spray cone angle, S_ca, and how is this one affected by rail pressure and back pressure, we can conclude that the S_ca, is more sensitive to back pressure variation than rail pressure. (Fig 8)

- Analyzing Fig 9, it is obvious that S_ca, is more affected by back pressure, than the injected quantity.

## ACKNOWLEDGMENTS

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