Development and Increasing the Salvage of DLL Nozzle by Using Distinct Methodology

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ABSTRACT

Needle salvage is the process where scrap Nozzle formed and that scrap nozzles are reused for second methodology. In that nozzle there are two parts and these are body and needle. We will reprocessing some machining process on needle and reused that needle also reducing high Hydraulic Through Flow(HTF) value by using new developing process and utilization of rejection by using HTF checking and decreases the nozzle loss. If there thousands of nozzle getting scrap, we can reduce scraping of nozzle upto fifty to sixty percent by using new developed methodology and also recovery of scraped nozzle is done and we will reducing the loss of nozzle.

Index Terms- Needle salvage, Scrap of Needle, HTF.

1. Introduction

More than 100 nozzles are rejected daily in Hydraulic through flow (HTF) checking operation. In HTF checking the flow value through nozzle per thirty sec is measured. The flow value has a specified range as per the type of nozzle. If the HTF value is less than the specified limit the part is called HTF less part & if the HTF value exceeds the limit then it is called HTF more part. The nozzle which are HTF more are directly scraped which leads to loss of rupees hundred behind every nozzle. Also the delivery of parts to the customer gets delayed if rejection increases.

Developing new process for rejected part due to which its HTF value will come in specified range:

Examples are

1) Type 769 - specified range of HTF value (700 to 766) cm3 /30sec
2) Type 1406 - specified range of HTF value (579 to 621) cm3 /30sec

For problem solution and new process development we need to go through trial and error method, first we go for detailed study of product geometry and it's working.

Product Information

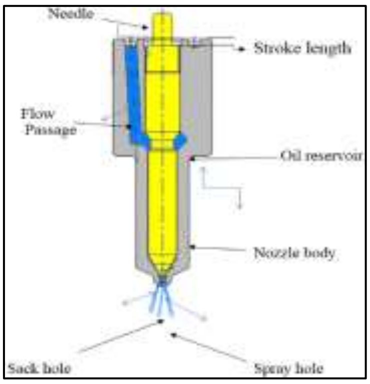

Fig 1.1 DLL Nozzle Assembly

Fuel from fuel pump is fed down to nozzle mouth through long drilled passage. The fuel pressure acts on the differential area of the nozzle valve (needle) which lifts against the spring Pressure and thus allows the fuel to enter into the cylinder via small hole in the form of an atomized spray. It should be noted that valve spring pressure is always less than the valve closing pressure due to the fact that once the valve lifts from the seat the area in contact with high pressure fuel increases and therefore less pressure is needed to keep the valve open.

Oil at very high pressure (more than 100 bar) provide to flow passage, this oil collected at oil reservoir. High pressure oil then travel at very high velocity to the sack hole due to up and down movement of needle. Oil which is very high pressure and velocity passed through spray holes in the form of fine particles which is required for effective running of engines.

Spray Formation

When fuel is forced through nozzle hole under high pressure it is disintegrated into fine Droplets due to aerodynamic resistance of the dense air present in the combustion chamber. Disintegration of fuel depends on:

1. Relative velocity of fuel and air.
2. Physical characteristics of fuel and air.

At the start of the full injection the pressure difference across the spray hole is low. Therefore single droplets are formed .As the pressure difference an increase following process occurs one after other:

1. Stream of fuel emerges from the nozzle.
2. Stream encounters aerodynamic resistance from the sense air present in the combustion chamber and breaks into spray.
3. With further and further increase in the pressure difference the brake up distance and cone angle increases and spray formation of in atomize form takes place.

The spray from circular spray hole has a dense and compact core surrounded by a cone of fuel droplets of various sizes and vaporized liquid. Large droplets provide a higher penetration into the chamber but smaller droplets are requires for quick mixing and evaporation of the fuel.

2. Literature Survey

Researchers such as Araneo et al. (Araneo et al., 1999), Gong et al. (Gong et al., 1992), and Kuniyoshi et al. (Kuniyoshi et al., 1980), have used various constant volume vessels to simulate the in-cylinder conditions of diesel engine for fuel spray research, both for non-evaporating and evaporating spray studies. Kosaka et al. (Kosaka et al., 1992) extensively used a rapid compression machine with combustion chamber to study the structure of diesel sprays. While, high pressure spray chamber was used to look at specific characteristics of the spray such as spray penetration, spray angle, drop size distribution and velocity by researchers such as Hiroyasu and Arai (Hiroyasu and Arai, 1990), Kozma and Farrell (Kozma and Farrell, 1997), Naber and Siebers (Naber and Siebers, 1996), Rajalingam and Farrell (Rajalingam and Farrell, 1999), and Siebers (Siebers, 1998). Although some of these studies were performed at elevated temperature and pressure, simulation of the conditions in theactual diesel engine that include the shape of the combustion chamber and the flow of the gases are very difficult. Therefore, many research labs used an operating single cylinder diesel engine, either based on a heavy-duty production engine or a dedicated research engine to study the diesel spray phenomena. Optical access through the combustion chamber of the above `engine' at various location is made possible by having quartz or sapphire windows on the sides of the combustion chamber in the cylinder head of the engine, using an elongated piston with transparent crown or by using an engine that allows optical access with a combination of the above. Another type of access to the combustion chamber is one of the earlier measurement techniques of spray structure was by direct measurement of the spray using conductivity technique. Conductivity is based on the measurement of the electric resistance between the nozzle and a metal placed in the spray jet.

Chehroudi et al. (Chehroudi et al., 1985) used a1 mm diameter needle that was moved gradually into the spray while Hiroyasu and Arai (Hiroyasu and Arai, 1990) used a fine wire net detector to measure the spray resistance. Recent measurement by Yule and Salters (Yule and Salters, 1995), employed an intrusive probe technique by using a refined conductivity probe to measure the break-up length of transient diesel sprays. Other observation of diesel engine fuel spray such as spray tip penetration and spray angle can be done by using high speed photography techniques such as direct photography or back illumination photography technique indicated that high-speed photography technique allows investigation of the spatial and time variation of the spray properties. Direct photography is the least complicated technique but only liquid fuel and flame can be recorded.

In another investigation, Dec and Espey (Dec and Espey, 1995) used the LII method to study the early soot development in the combustion chamber of a direct injection diesel engine. Other technique includes the Laser Induced Fluorescence (LIF) which utilises the laser radiation absorption principle to excite molecules to higher energy levels. Point measuring techniques such as Laser Doppler Velocimetry (LDV) measures the target speed by comparing the scattered light and reflective wave off a target with the original light as used by Coghe (Coghe and Cossali, 1994; Coghe, 2000) and Araneo et al. (Araneo et al., 1999). Baritaud et al. (Baritaud et al., 1994) used the LDV techniques to measure the field velocity of the air in an optical model engine. Particle Image Velocimetry (PIV) records the images obtained from illuminated particle by a double-pulsed sheet of light and analysis by a spatial autocorrelation of small regions of the image.

3. Methodology

a Methodology I

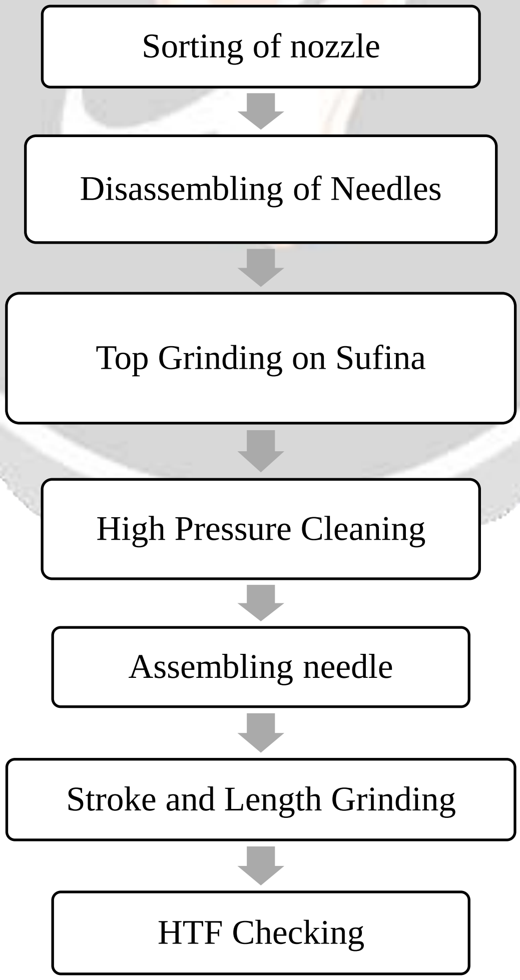

Fig 3.1 Old Methodology

Sorting of nozzle

All the HTF more parts are kept in trays. They are of different types as they were going to scrap them. To apply a repair procedure we have to sort out the nozzle as per their type because there HTF value varies according to their type.

For example, for type 1335 the HTF value lies between 531-569 cc/30 sec and for type 1406 value lies between 579 - 621 cc/30 secs.

So all the nozzle are sorted as per there type.

Disassembly of Nozzle

As we want to grind the top surface of the nozzle body it is essential to remove the needles from it. we placed that needles sequentially so that while doing the assembly of needle and nozzle body the respective needles are placed in their respective bodies.

Top Grinding on Supina Machine

Supina machine is the special purpose machine used grind the top of nozzle body.

The following characteristics are maintained on the supina machine.

1) Collar height
2) Parallelise
3) Top flatness
4) Roughness value

We visually also check that no burning marks or rough lines appears on the top of the nozzle body.

Trial: Changing Cut on Divided Parts Type: 1320

HTF Limits: 620 cc/30 sec to 673 cc/ 30 sec

We divide the number of parts into 3 groups to cut on the supfina machine and length of cut is varied between 170µm to 190µm depending upon HTF value. As following

1) Parts which have HTF more value in between 0 to 3 % of upper limit - 170 µm
2) Parts which have HTF more value in between 3 to 5 % of upper limit- 180 µm
3) Parts which have HTF value in between 5% and more- 190µm

Table 3.1 HTF value & cut on Supfina

Sr No	HTF Value	Cut on SUPFINA
1	Upto 3% of Upper Limit	170 µm
2	Upto 3 - 5 % of Upper Limit	180 µm
3	Greater than 5 % of Upper Limit	190 µm

We grind the nozzle body which was sorted according to the HTF more value on the supfina machine. We maintain the required characteristics such as Collar height, Parallelism, Top flatness, Roughness value. After grinding of nozzle body this nozzles and needle are assemble with high pressure cleaning then nozzle assembly checked on HTF machine to find out variation in HTF value than previous HTF value.

b **Methodology II**

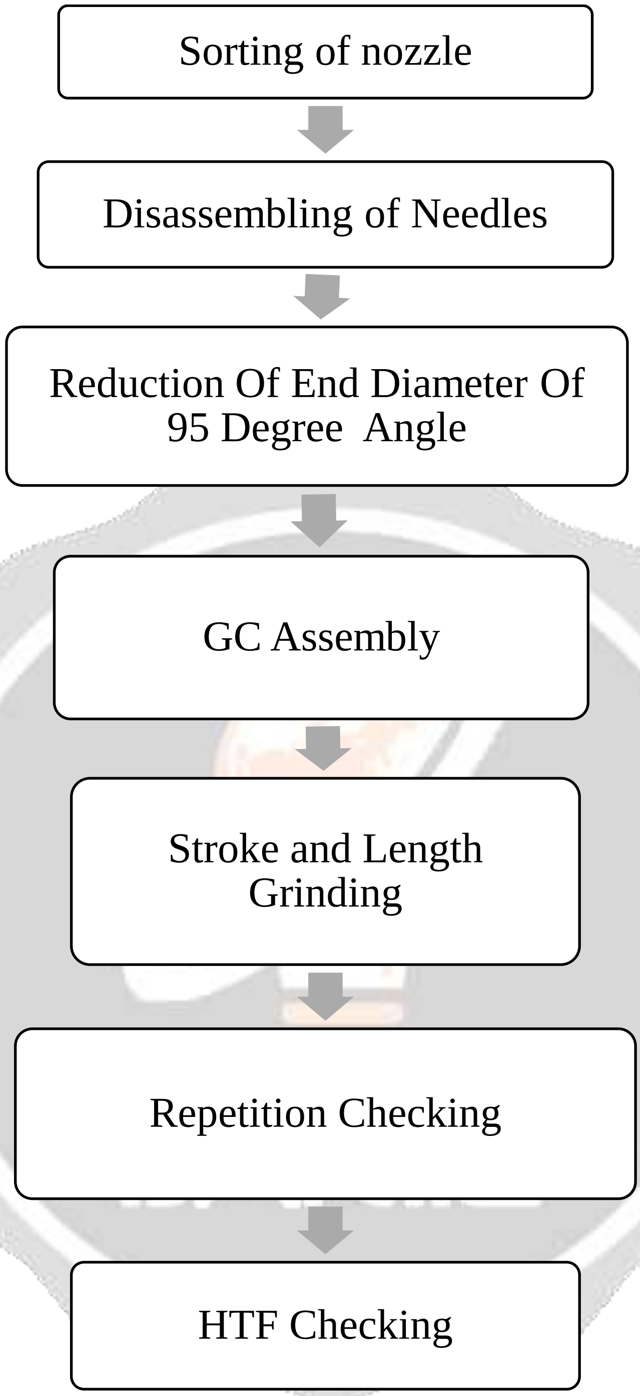

Fig 3.2 New Methodology

Sorting of nozzle

All the HTF more parts i.e. rejected by first methodology are kept in trays. They are of different types as they were going to scrap them. To apply a repair procedure we have to sort out the nozzle as per their type because there HTF value varies according to their type.

For example, for type 1335 the HTF value lies between 531-569 cc/30 sec and for type 1406 value lies between 579 - 621 cc/30 secs.

So all the nozzle are sorted as per there type.

Disassembly of Nozzle

As we want to work only on needle seat angle it is essential to remove the needles from nozzle assembly. We placed that nozzle body sequentially so that while doing the assembly of needle and nozzle body the respective needles are placed in their respective bodies.

Reduction of End Diameter of 95 Degree Angle

Initially end diameter of 95 degree is in between 1.1 to 1.3 mm, the area of sack hole is more so that oil in sack hole accumulated are more and it results in giving HTF value more. To reduce HTF value we reduce the end diameter of 95 degree angle as shown in figure is reduced and kept in 0.9 to 1.1 mm so than HTF value reduces. This operation is done by special purpose grinding machine.

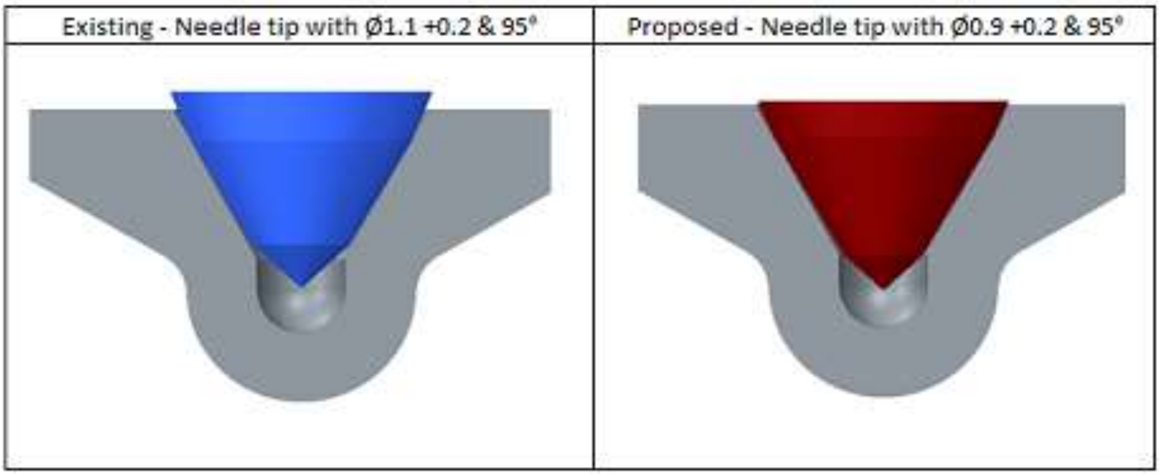

Fig 3.3 Existing & modified needle tip diameter

GC assembly

After completion of grinding operation needles are assembled into the body as per type of nozzle assembly. Here care should be taken to insert the needle into the predefined body. In this operation clearance between nozzle body and needle is maintain as per design specification. Generally clearance maintain between 0.1 to 0.2 mm.

Stroke and Length Grinding

In this process stroke of the nozzle assembly is again grind and maintain at lower side. Generally stroke maintain in between 0.23 to 0.25mm.

Repetition checking

As we work on the seat of the needle which lands on the sack hole & thus affects the area of the sack hole. It is essential to carry out the repetition checking.

In repetition checking operation test oil about 100 bar is passed through the nozzle assembly, if the oil coming out through the spray holes is in atomize form then the part is accepted and if not it is rejected.

HTF checking

At this work station the hydraulic through flow value of the repair parts is checked. The ok parts are sent for packaging & the parts exceeding the specified HTF value are rejected.

4. Conclusion

In the paper we studied salvage of Needle by using distinct methodology, by using this process we reduces scrap and increases productivity.

1. By top grinding 45-50 % recovery is done.
2. By reducing needle diameter of 95 degree 70-77 % recovery.
3. The part which were going to be scrap are repaired hence cost saving is done.

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