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Mechanical & Mechanics Engineering

Highlights

- Four Stroke Compression
- Hardfacing of AISI
- Forged Steel Crankshaft
- Experimental Investigations

Discovering Thoughts, Inventing Future

VOLUME 13 ISSUE 4 VERSION 1.0

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Experimental Investigations on a Four Stroke Compression Ignition Engine using Neat Tobacco Seed Oil as an Alternate Fuel

By Dr.C.V.MohanRao, Dr.A.V.Sita Rama Raju & Dr.K.Govindarajulu
University College of Engineering (Kakatiya University), India

Abstract - Performance, emission and combustion tests were carried out on a four stroke compression ignition engine using tobacco seed oil by varying fuel injection pressure and fuel injection timing and compared with base line diesel. The main objective of conducting the performance test on a most widely used agricultural segment engine with tobacco seed oil to help the farming community to use tobacco seed oil in case of emergency and short term applications. At 260 Bar and 26° BTDC the performance of the engine is quite encouraging compared to the operation of the engine at standard injection pressure of 205 bar and 23° BTDC.

Keywords : alternate fuel, tobacco seed oil, performance, emission, combustion, diesel, fuel injection pressure, fuel injection timing.

GJRE-A Classification : *FOR Code: 850402*

EXPERIMENTAL INVESTIGATIONS ON A FOUR STROKE COMPRESSION IGNITION ENGINE USING NEAT TOBACCO SEED OIL AS AN ALTERNATE FUEL

Experimental Investigations on a Four Stroke Compression Ignition Engine using Neat Tobacco Seed Oil as an Alternate Fuel

Dr.C.V.MohanRao [α], Dr.A.V.Sita Rama Raju [σ] & Dr.K.Govindarajulu [ρ]

Abstract - Performance, emission and combustion tests were carried out on a four stroke compression ignition engine using tobacco seed oil by varying fuel injection pressure and fuel injection timing and compared with base line diesel. The main objective of conducting the performance test on a most widely used agricultural segment engine with tobacco seed oil to help the farming community to use tobacco seed oil in case of emergency and short term applications. At 260 Bar and 26° BTDC the performance of the engine is quite encouraging compared to the operation of the engine at standard injection pressure of 205 bar and 23° BTDC.

Keywords : alternate fuel, tobacco seed oil, performance, emission, combustion, diesel, fuel injection pressure, fuel injection timing.

I. Introduction

The depletion of fossil fuels all over the world is pressing the people to search for alternative fuels. Mostly the research is going on tree based oil seeds for the extraction of oil and conversion of these oils as bio diesel for the purpose of IC engine applications. The tree based oil seed production takes longer time compared to plant based oil seed production. Countries like Argentina, China, Brazil, Bulgaria, Greece, India, Indonesia, Turkey, Tunisia, etc are cultivating tobacco for commercial purpose. In majority of the tobacco cultivation process only the tobacco leaves are used and the tobacco seeds are unused (1,2,3). Due to the worldwide tobacco abuse the crop cultivation is coming down. If the tobacco seeds which are left out in the tobacco fields are used for tobacco seed oil extraction then it can be used for many useful applications. emergency and short term application for the agricultural segment engines like water pumps, diesel generators, power tillers etc. In some of the tobacco growing countries due to the shortage of cooking oil the tobacco seed oil is being used as edible oil after due processing of this oil after removal of toxic contents as it contains omega-3 fatty acid which is essential for human body(1).

The oil cake emerging from the tobacco seed oil extraction can be used as a good manure for the agricultural fields moreover the fuel import bills will come down and this will strengthen any nation for its energy self sufficiency. For this purpose if the engine is tuned by varying the fuel injection pressure and timing to yield best performance such that the unused tobacco seeds can be converted to most useful fuel. In the present experimental investigation the engine performance, emission and combustion characteristics using tobacco seed oil as fuel at fuel injection pressures of 205, 220, 240 and 260 bar and fuel injection timing of 23°, 26°, 28° BTDC were evaluated and compared with base line diesel operation.

II. Characterisation of Tobacco Seed Oil

The details of tobacco plant and properties of tobacco seed oil are given below.

a) Tobacco Plant

Initially the tobacco plants are raised from tobacco beds as is done in the case of paddy plantation. The small tobacco plants are then planted in an array and frequently irrigated. The tobacco plant grows from 1 meter to 2 meters in height and after attaining maximum height beautiful pink flowers will emerge. These flowers will turn to green capsules containing numerous tobacco seeds. When these green capsules turn to brown colour after considerable drying the tobacco seeds will be ready for oil extraction and the oil yield will be around 25 to 30%.

b) Tobacco seed oil

The tobacco seed oil in sufficient quantities were procured from Sri Laxmi venkatesh wara oil mill, Santhanuthalapadu, Prakasham district, Andhra Pradesh. The fatty acid composition of tobacco seed oil is shown in Table.1 and the fuel properties are shown in Table 2.

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II. Experimental Setup

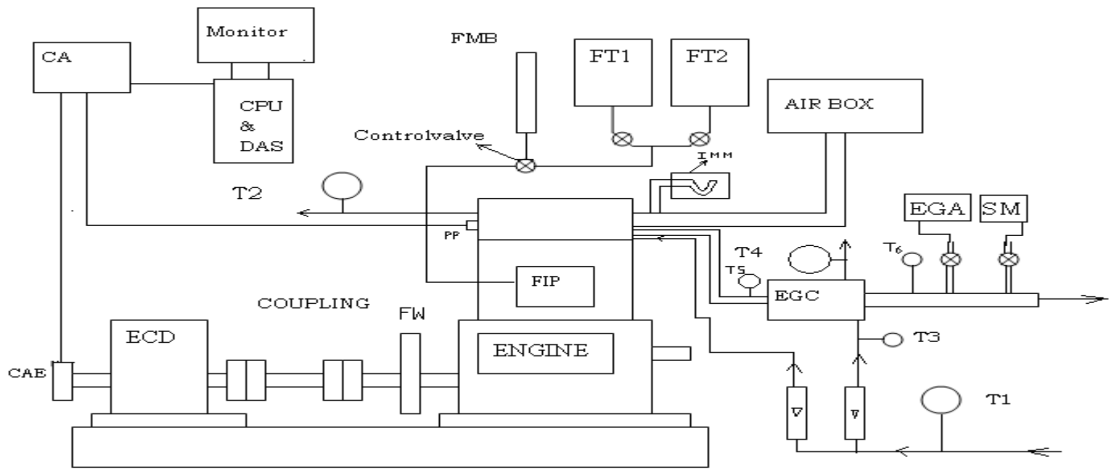

Figure 1 : Schematic diagram of experimental set-up

FW – Fly Wheel
ECD – Eddy Current Dynamometer
CAE – Crank Angle Encoder
CA – Charge Amplifier
CPU & DAS – Central Processing Unit & Data Acquisition System
PP – Pressure Pickup Transducer
FMB – Fuel Measuring Burette
FT1 & FT2 – Fuel Tanks
FIP – Fuel Injection Pump
IMM – Inlet Manifold Manometer
EGC – Exhaust Gas Calorimeter
EGA – Five Gas Exhaust Gas Analyzer
SM – Smoke Meter
T1 – Engine Inlet Water temperature
T2 - Engine Outlet Water temperature
T3 – Inlet Cooling Water Temperature To the exhaust Gas Calorimeter
T4 - Outlet Water Temperature of the exhaust Gas Calorimeter
T5 – Exhaust Gas Temperature before Calorimeter
T6 - Exhaust Gas Temperature after Calorimeter

III. Experimental Procedure

A four stroke single cylinder direct injection water cooled computerized Kirloskar TV1 diesel engine shown in fig.1 is used for testing the performance by enhancing fuel injection pressure and fuel injection advance. After ensuring no load on the eddy current dynamometer the engine was started on base line diesel and performance, emission and combustion tests were conducted using base line diesel as fuel at manufacturers recommended fuel injection pressure of 205 Bar and fuel injection timing of 23° BTDC. The performance, emission and combustion characteristics are plotted by varying 20, 40, 60, 80 and 100% load with base line diesel operation.

The performance emission and combustion tests were conducted using tobacco seed oil following the above procedure to evaluate the performance and emission analysis at different injection pressures (205, 220, 240 and 260 bar) and keeping the fuel injection timing at 23° BTDC. Before introducing tobacco seed oil as test fuel, the engine was run on base line diesel for 10 to 15 minutes and after stabilizing the engine parameters, the tobacco seed oil was introduced. After running the engine for 10-15 minutes on the tobacco seed oil and stabilizing the parameters with the tobacco seed oil the readings were recorded and after completion of the tests with tobacco seed oil the engine was switched over to base line diesel and run for 10 to 15 minutes on base line diesel before stopping the engine to avoid cold starting and fuel injector and fuel pump plunger sticking problems.

The above test procedure is repeated by keeping the fuel injection timing at 26° and 28° BTDC and the fuel injection pressure at 205, 220, 240 and 260 Bar.

Uncertainity Analysis: The experimental investigations involve the use of different instruments for measurement of different parameters. These instruments or equipment are made by different manufacturers using different technologies. The accuracy of measurement and their performance may vary depending on the operating and experimental environment. Hence the uncertainty occurs due to fixed or random errors. The uncertainty in the measured parameter can be estimated based on analytical methods. Thus the uncertainty can be estimated using Gaussian distribution method with confidence limits of 2 σ

Using the above equation for a given operating condition the uncertainties are computed for the measured quantities are listed below

N= Speed ± 1.0 %
W= Load ± 0.5 %
BP= Brake Power ± 0.5 %
BSFC= Brake specific fuel consumption ± 1.4 %
EGT= Exhaust gas temperature ± 0.2 %
BTE = Brake thermal efficiency ± 1.1 %
CO= carbon Monoxide ± 0.2 %
HC= Hydro carbon ± 0.2 %
NOx= Oxides of Nitrogen ± 0.3 %
SO= Smoke opacity ± 1.1 %
PP = Pressure pickup ± 1.0 %

S.No	Instruments	Measured Parameters	Measurement Accuracy	Percentage uncertainties
1	5GAS ANALISER	CO (0-15%) HC (0-30000PPM) NOx (0-5000PPM) O2 (0-25%) CO2 (0-20%)	0.01% 1PPM 1PPM 0.01% 0.01%	± 0.2% ± 0.2% ± 0.3% ± 1.1% ± 1.0%
2	SMOKE METER	SMOKE OPACITY(0-99.99)	1%	± 1.1%
3	LOAD INDICATOR	LOAD(0-50kg)	± 0.1kg	± 0.5 %
4	PRESSURE PICKUP	PRESSURE (0-110Bar)	±1 Bar	± 1.0 %
5	CRANK ANGLE ENCODER		±1°	±0.2%
6	EXHAUST GAS TEMPERATURE INDICATOR	TEMPERATURE (0-900°C)	±1°C	± 0.2%
7	SPEED	SPEED (0-10000RPM)	±10RPM	± 1.0%
8	FUEL MEASURING UNIT	FUEL CONSUMED (0-50CC)	0.2CC	± 1.4 %

S.NO	Parameters	Specification
1	Machine supplier	Apex innovations Pvt. Ltd., Sangli, Maharastra, India
2	Type	TV1. (Kirlosker make)
3	Software used	Engine Soft
4	Nozzle opening pressure	200-225 bar
5	Governor type	Mechanical centrifugal type
6	No of cylinders	Single cylinder
7	No of strokes	Four stroke
8	Fuel	H.S.diesel
9	Rated power	5.2kW(7HP)@1500rpm
10	Cylinder diameter	87.5mm
11	Stroke length	110mm
12	Compression ratio	17.5P:1

Air measurement manometer		
13	Made	MX 201
14	Type	U-type
15	Range	100-0-100mm
Eddy current dynamometer		
16	Model	AG-10
17	Type	Eddy current
18	Maximum	7.5kW at 1500-3000 rpm

IV. Results & Discussions

The variation of brake specific energy consumption of tobacco seed oil with respect to brake power is presented in Fig.2. For both diesel and tobacco seed oil operation the brake specific energy consumption was decreased with increase of brake power up to 80% load and at this point the lowest brake specific energy consumption for diesel, tobacco seed oil at best injection pressure and timing and tobacco seed oil at standard setting of injection pressure and timing are 12837.82, 14245.58, 16479.86 kJ/kWh respectively. Hence 19% saving in brake specific energy consumption with tobacco seed oil can be achieved by adopting best injection pressure and timing over standard setting of injection pressure and timing.

Fig.3. shows the variation of exhaust gas temperature with brake power. The exhaust gas temperature with tobacco seed oil is lower than diesel operation. This is due to higher heating value of diesel fuel. However with tobacco seed oil at standard setting of injection pressure and timing the exhaust gas temperatures are very close to diesel operation indicates the ineffective combustion due to lower injection pressure which leads to after burning.

The variation of brake thermal efficiency with brake power is shown in Fig.4. The highest brake thermal efficiency is obtained at around 4 kW with both diesel and tobacco seed oil. Throughout the operating range the brake thermal efficiency is higher with diesel compared to tobacco seed oil. The peak brake thermal efficiency with diesel, tobacco seed oil at best setting and tobacco seed oil at standard setting of injection pressure and timing are 28.05%, 24.92%, 21.54% respectively. The decreased values of brake thermal efficiency with tobacco seed oil over diesel indicates lower heating value and poor combustion due to high viscosity of tobacco seed oil. However with best setting of fuel injection pressure and timing there is 15.7% increase in brake thermal efficiency over standard setting with tobacco seed oil. This improvement in brake thermal efficiency can be attributed to improved combustion due to higher injection pressure and advanced injection timing.

Concentration of unburnt hydrocarbon emission variation with brake power is represented in Fig.5. Higher values of unburnt hydrocarbon with tobacco seed oil over diesel indicates improper combustion of tobacco seed oil due to more heterogeneous mixture formation resulting from higher viscosity and low volatility.

Emission of carbon monoxide variation with brake power is indicated in Fig.6. The carbon monoxide emissions are very low in all the cases as expected in any of the compression ignition engines due to the presence of excess air. However there is an indication of slightly higher values of carbon monoxide with tobacco seed oil over diesel operation.

The variation of Oxides of Nitrogen emissions with brake power is shown in Fig.7. There is higher Oxides of Nitrogen concentration in the exhaust of tobacco seed oil operation when compared to diesel. This is obvious due to the more availability of oxygen with tobacco seed oil as the tobacco seed oil itself contains oxygen in its molecular structure. However with tobacco seed oil at best injection pressure and timing the Oxides of Nitrogen emissions are higher over that of at standard setting due to prevailing of higher combustion temperatures. When the engine was operated on tobacco seed oil at best setting of injection pressure and timing at 80% load Oxides of Nitrogen emissions were 425 ppm and that of base line diesel operation were 126 ppm. At standard setting of injection pressure and timing Oxides of Nitrogen were 299 ppm.

Fig.8. shows the variation of smoke opacity with brake power. The smoke intensity is higher with tobacco seed oil as compared to diesel due to higher viscosity of tobacco seed oil leading to thermal cracking. At 80% load when the engine operated on tobacco seed oil at best setting of injection pressure and timing smoke level is 46% lower compared to the tobacco seed oil operation at standard setting of injection pressure and timing.

Fig.9 explains pressure versus Crank Angle data pertaining to tobacco seed oil at standard and best injection pressure at 80% load. The effect of increase in fuel injection pressure from 205 bar to 260 bar and advancing the fuel injection timing from 23° BTDC to 26° BTDC improves the peak pressure from 65.38 bar to 74.9 bar. This may be due to the decrease in ignition delay as a result of enhanced injection pressure and advanced fuel injection timing.

Fig.10 indicates the rate of pressure rise versus Crank Angle and when the injection pressure is increased the maximum rate of pressure rise increased from 3.77 bar /°Crank Angle to 4.85 bar/°Crank Angle.

Fig.11 shows the highest net heat release rate which increases from 35.9 Joules /°Crank Angle to 44.11 Joules/°Crank Angle indicating the improvement of net heat release rate with the increase in fuel injection pressure and advanced fuel injection timing.

The cumulative heat release is shown in Fig.12 There is an improvement of highest cumulative heat release from 1.14 kJ at 509 °Crank Angle to 1.17 kJ at 423 ° Crank Angle. For diesel the highest cumulative heat release value of 0.91 kJ at 391°Crank Angle was observed.

The mass fraction burnt in % is shown in Fig.13 The 5% mass fraction burnt for diesel, tobacco seed oil at standard and best settings are 354, 358 and 354°Crank Angle respectively. The 90% mass fraction burnt for diesel, tobacco seed oil at standard and best settings are 375, 381 and 379°Crank Angle respectively. The occurrence of 5% and 90% mass fraction burnt with best setting of injection pressure and timing has been advanced by 4° and 2° crank Angle compared to standard setting of injection pressure and timing.

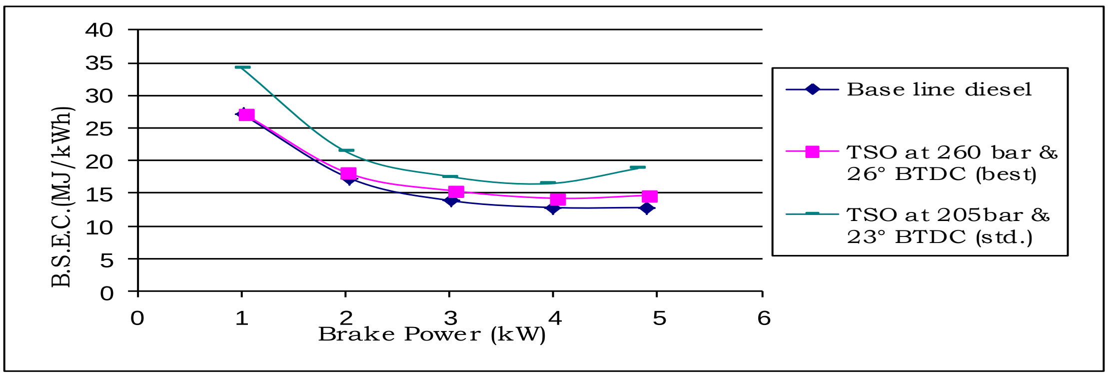

Figure 2 : BSEC Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

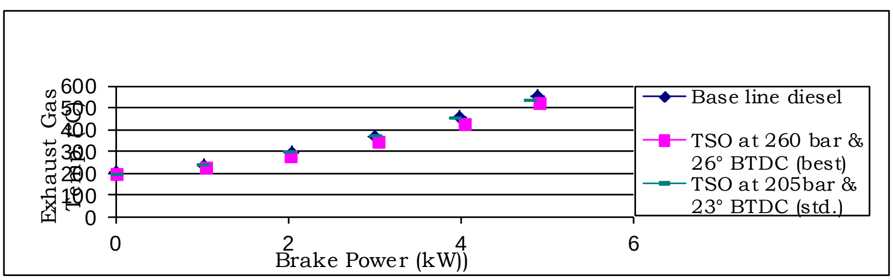

Figure 3 : Exhaust Gas Temperature Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

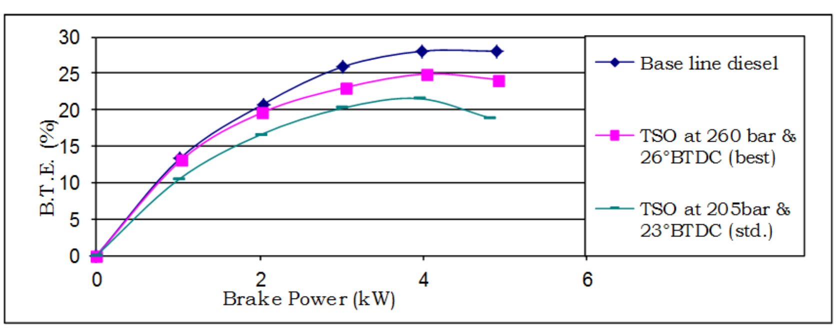

Figure 4 : Brake Thermal Efficiency Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

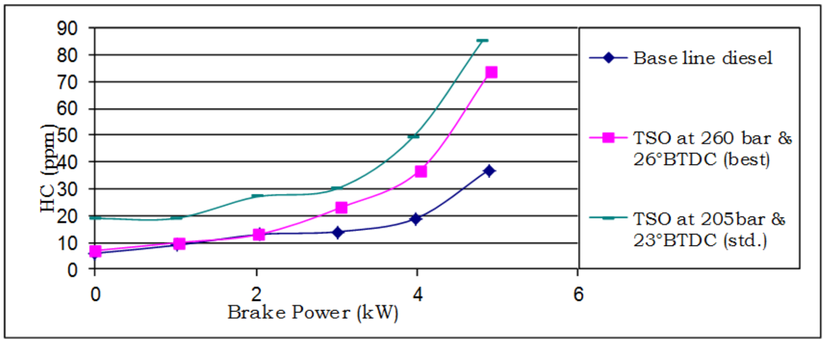

Figure 5 : Unburnt Hydro Carbon Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

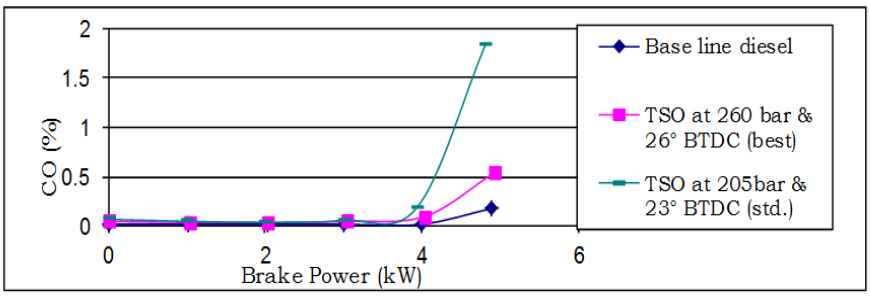

Figure 6 : Carbon Monoxide Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

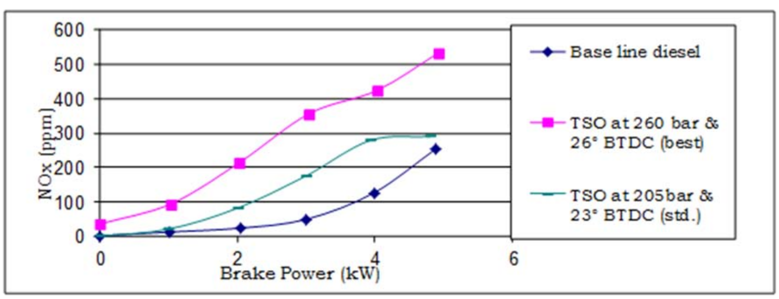

Figure 7 : Oxides of Nitrogen Vs Brake Power of tobacco seed oil at standard and best injection ressure and timing

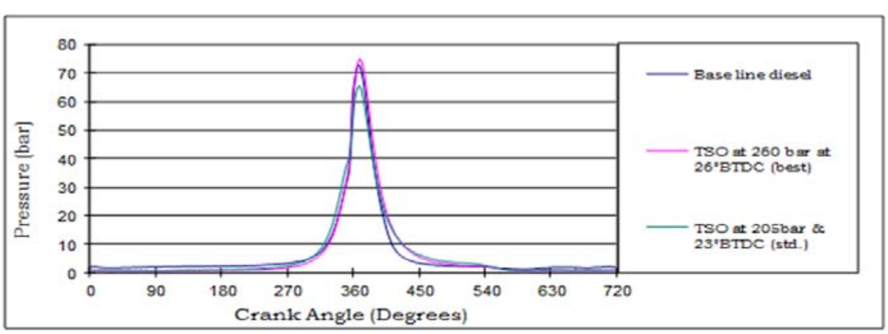

Figure 8 : Smoke Opacity Vs Brake Power of tobacco seed oil at standard and best injection pressure and timing

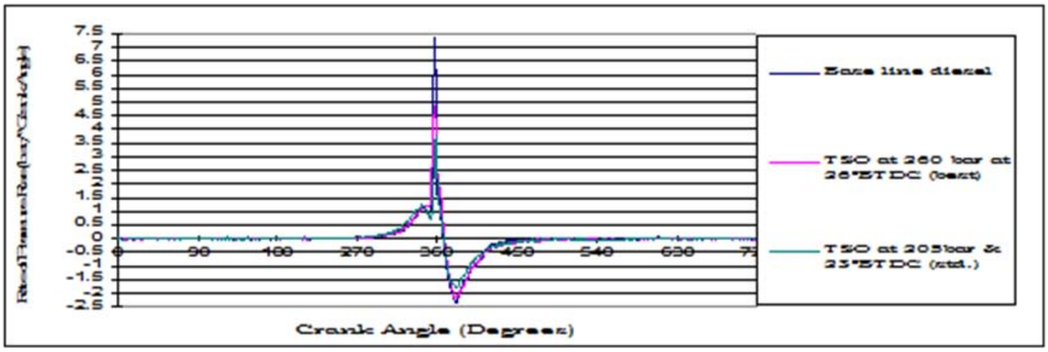

Figure 9 : Pressure Vs Crank angle of tobacco seed oil at standard and best injection pressure and timing at 80% load

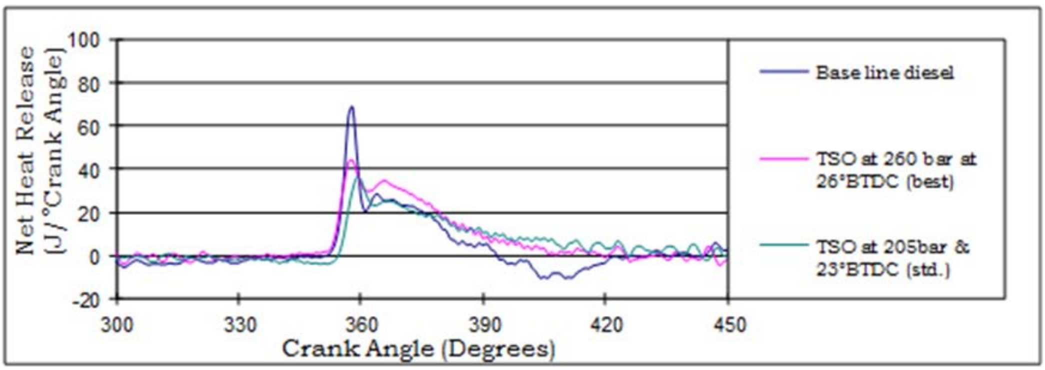

Figure 10 : Rate of Pressure Rise VsCrank angle of tobacco seed oil at standard and best injection pressure and timing at 80% load

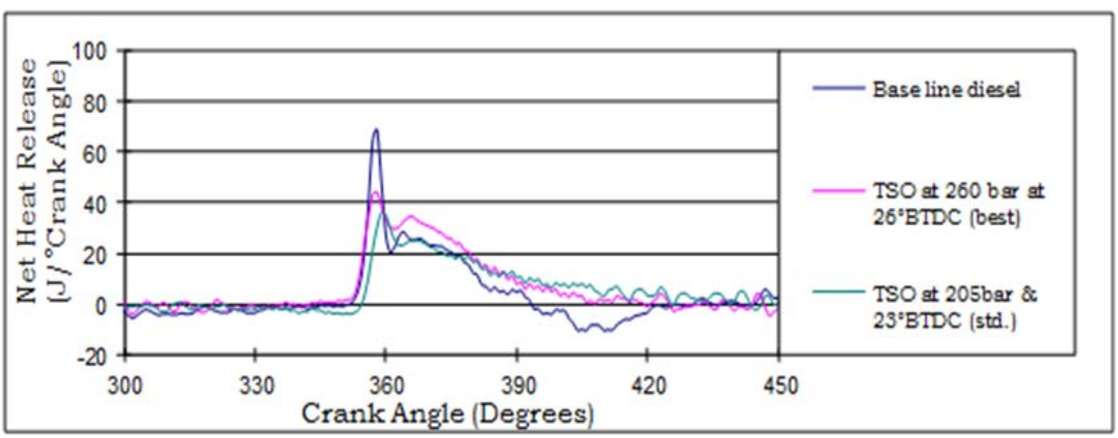

Figure 11 : Net Heat Release Vs Crank angle of tobacco seed oil at standard and best injection pressure and timing at 80% load

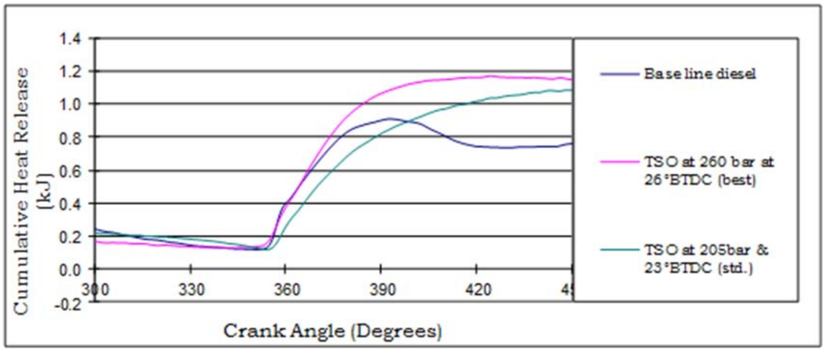

Figure 12 : Cumulative Heat Release Vs Crank angle of tobacco seed oil at standard and best injection pressure and timing at 80% load

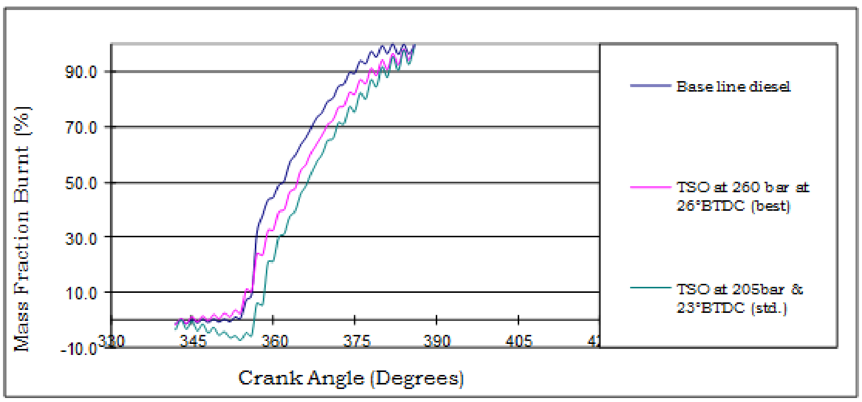

Figure 13 : Mass Fraction Burnt Vs Crank angle of tobacco seed oil at standard and best injection pressure and timing at 80% load

Table 1

Fatty acid composition	Tobacco seed oil
Myristic (14:0)	0.09-0.17
Palmitic (16:0)	10.96-8.87
Stearic (18:0)	3.34-3.49
Oleic (18:1)	14.54-12.4
Linoleic (18:2)	69.49-67.75
Linolenic (18:3)	0.69-4.20

Table 2

Properties	Tobacco seed oil	Base line diesel
Density at 32° C in gm/cc	0.915	0.82
Kinematic Viscosity at 32 °C in C s T	24	4
Flash point ° C	230	52
Fire point	248	57
Carbon residue (%)	0.45	0.1
Calorific value k J/kg	38438	42000

Table 3 : Test rig specifications

S. No.	Description	Specification
1	Test rig supplier	Apex Innovations Pvt.Ltd. Sangli Maharastra state, India
2	Type	TVI (Kirlosker make) vertical, water cooled
3	Software used	Engine soft
4	Nozzle opening pressure	200-260 bar
5	Governor type	Mechanical centrifugal type
6	No. of cylinders	Single cylinder
7	No. of strokes	Four stroke
8	Fuel	H.S. Diesel
9	Rated power	5.2 KW (7 HP) at 1500 rpm
10	Cylinder diameter (bore)	87.5 mm
11	Stroke length	110 mm
12	Compression ratio	17.5:1

V. Conclusions

The tobacco seed oil can be used as an alternate fuel in cases of emergency and short term use with proper precautions and tuning of the engine for best performance level. When the engine is operated with tobacco seed oil at best injection pressure and timing of 260 bar and 26° BTDC over standard setting of injection pressure and timing of 205 bar and 23° BTDC, 19% decrease in brake specific fuel consumption, 15.7% increase in brake thermal efficiency at 80% load and lower emissions were observed. The combustion data reveals improvement in peak pressure from 65.38 bar to 74.9 bar, maximum rate of pressure rise from 3.77 bar /°Crank Angle to 4.85 bar/°Crank Angle, highest net heat release rate from 35.9 Joules /°Crank Angle to 44.11 Joules/°Crank Angle, highest cumulative heat release from 1.14 kJ to 1.17 kJ and mass fraction burnt parameters. Hence for this particular engine 260 bar fuel injection pressure and 26° BTDC fuel injection timing is a best option to run with neat tobacco seed oil for emergency and short term applications.

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Comparative Study of Hard facing of AISI 1020 Steel by Three Different Welding Processes

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COMPARATIVESTUDY OFHARD FACING OF AISI 1020 STEEL BY THREE DIFFERENT WELDING PROCESSES

Strictly as per the compliance and regulations of :

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Keywords : AISI 1020 steel, hardsur facing, gas welding, arc welding, TIG welding, wear property.

I. Introduction

Hardfacing or Hardsurfacing, is the application of build-up of deposits of specialized alloys by means of welding process to resist wear and tear by abrasion, corrosion, high temperature, or impact. Such deposition can be done on the surface, or edge, or merely at the point of a part where it is subjected to wear [Pradeep *et al.,* (2010)]. Welding is a key technology to fulfil these requirements and to apply hardfacing alloys [Kirchgaßner *et al.,* (2008)]. These welding deposits can help to reclaim the components by extending their service life [Agustín *et al.,* (2010)]. A hard-faced part is like a laminate, with the base material contributing for strength and economy, and the hard-facing material contributing for the specific wearing conditions to which the part will be subjected in service. Hard facing may be applied to new parts during, or to worn parts to restore a worn-down surface. Hard-facing extends the lifetime of machinery equipment efficiently by increasing the service life of its parts,. [Kirchgaßner *et al.,* (2008)]. In order to avoid costly downtimes and to reduce the cost of expensive spare parts, the core components that are exposed to heavy wear, require efficient surface protection measures [Kirchga ßner *et al.,* (2008)]. Weld hard facing has been adopted in many industries like Mining, Steel, Petro-chemical, Cement, Power, Food and Sugar cane [Kirchga ßner *et al.,* (2008)]. In recent years, these processes have been developed rapidly and are now applied in numerous industries, such as nuclear and steam power plants, chemical and fertilizer plants, agriculture machines and pressure vessels, railways, and even in aerospace components [Richard LL (1990)]. Hard facing is mainly done to improve the surface properties of the base metal [Gourd LM (1998)].

II. Hard Facing Processes Used

A number of welding processes can be used to hardface the components. The various factors that control the selection of the most suitable welding process for a given job are: Size and shape of component, Base metal composition, Nature of work to which the component to be Hard-faced is subjected to, Accessibility of weld equipment, Function of the component, Number of same or similar items to be hard-faced and cost of replacement of the part, State of repair of worn components, etc [Pradeep *et al.,* (2010)]. The following processes are compared in the present study:

- Hardfacing by Gas welding - Deposition by Oxy-Acetylene Gas welding [Buchely *et al.,* (2005)].
- Hardfacing by Arc welding - Shielded Metal Arc Welding [Amado *et al.,* (2008)].
- Hardfacing by combination of Arc and Gas - Tungsten Inert Gas Welding [Kashani *et al.,* (2007)].

III. Base Material and Weld Consumable used in Hard Facing

Almost 85% of the metal produced and used in most applications comprises of Steel. The Low-Carbon Steels and Low-Alloy Steels used in the industry for making different components for different applications include the AISI series C-1008 to C-1020, 2315, 2515, and 2517 [Wang *et al.,* (2008)]. These steels generally have, 0.10 to 0.25% Carbon, 0.25 to 1.5% manganese, up to 0.4% (maximum) phosphorous, and 0.5%

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(maximum) sulfur. These steels can be easily welded with any of the welding processes. The other low-alloy high-strength steels of the AISI designation system include low-manganese steels, low nickel-chromium steels, low-to-medium nickel steels, nickel-chromium-molybdenum steels, chromium-molybdenum steels, molybdenum steels etc. [Wang *et al.,* (2008)]. These alloys are included in AISI series 2315, 2515, and 2517. They contain 0.12-0.30% Carbon, 0.40-0.60% manganese, 0.20-0.45% silicon and 3.25-5.25% nickel. In the present study AISI 1020 steel has been used for experimentation. In order to facilitate easy assessment of the effect of different welding processes on the wear of hard-faced components, same material has been used as base material and deposit material.

IV. Sample Preparation and Testing

The material used for the sample preparation is AISI 1020 steel. The chemical composition, physical and mechanical properties of the material are given in Tables 1 & 2:

Element	C	Mn	P	S	Fe
Composition (%)	0.18-0.23	0.30-0.60	0.04 (Max)	0.05 (Max)	Balance

Table 1: Chemical Composition of AISI 1020 Steel by Wt %

Property	Elastic Modulus (GPa)	Density (x 10^3 Kg/m^3)	Poisson's Ratio	Hardness (HB)	Tensile Strength (MPa)
Value	190-210	7.7-8.03	0.27-0.30	111	394.7

Table 2 : Physical and Mechanical Properties of AISI 1020 Steel

ASTM standards were used to prepare the test samples. 10 mm diameter round rods of AISI 1020 are taken and cut in to cylinders of required lengths as per ASTM standards. Finishing of samples is done by removing the burr and thorough cleaning of oil and dirt. AISI 1020 material is deposited on the flat face of each sample using three different welding processes- Gas welding, Arc welding and TIG welding (with Argon as Inert Gas). Turning is done with fine cuts to get smooth cylindrical finish and also maintain the required size as per ASTM standards. As the POD testing requires perfect contact, the ends of the samples are rubbed on a sand belt machine by holding the sample in drilling machine so that the test surface is perfectly flat. The Weld deposit height is maintained at least 5 mm in the total sample length as shown in figure 1. Computerized Pin on Disc Wear testing Machine with the sample as test material and High Carbon EN31 steel (HRC 60) as counter-surface equipped with LVDT and digital display system was used to record the wear height loss.

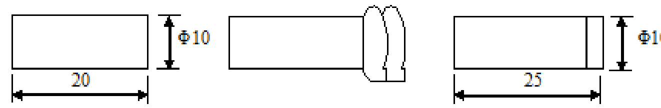

Figure 1 : Steps in Sample Preparation

V. Results and Discussion

In order to find out the wear characteristics at different sliding distances and different loads, four types of samples namely, plain Sample without welding, Gas welded sample, Arc welded sample and TIG welded sample, are tested on the POD machine. The load was varied from 9.81N to 49.05 N in steps of 9.81 N and three Sliding Velocities of 0.9426 m/s, 1.256 m/s, 1.571 m/s were chosen for the test. Each sample was tested for different sliding distances ranging from 282.78 m to 2827.8 m in steps of 94.26 m. The average of 8 readings is considered for calculation of parameters like Wear Volume, Wear Factor and Frictional Coefficient. These values are plotted on the graphs for analysis. The figures 2, 3, 4 show some sample graphs obtained for a particular sliding velocity and load.

a) Effect on Wear Volume

From the results it was observed (figure 2) that TIG welding sample was showing better the values of Wear Volume at Sliding Velocity of 0.9426m/s, compared to remaining three samples i.e, plain sample without welding, Gas welded sample and Arc welded sample. It was also observed that the values of these three samples are very close. Further it was also observed that at higher Sliding Velocities (above 1.256 m/s) the Wear Volume values of TIG welding sample were better than Gas Welding Sample and Arc Welding Sample even though all the values of these samples are closer to each other. May be the narrow heat affected zone of higher hardness than the base material in TIG welding might have offered resistance to wear and resulted in enhanced wear properties at lower sliding velocities compared to Gas Welding and Arc welding. However at higher sliding velocities of 1.571 m/s, the Wear Volume values of Gas welded samples and Arc welded samples were better compared to TIG welded samples. This may be due to broader heat affected zone of higher hardness in Gas welding and Arc welding which might have offered resistance to wear resulting in enhanced wear properties at higher sliding velocities. At higher velocities, the narrow heat affected zone of higher hardness in TIG welding might have reduced the resistance to wear, as the heat generation is higher, which in turn makes the metal to peel out in the form of chips. It was also observed that at higher sliding velocities of 1.571 m/s, Gas welding samples were showing slightly better Wear Volume values compared to Arc welding up to sliding distances of 1500 m at still higher sliding distances higher than 1500 m, the Arc welded samples were showing better Wear Volume values compared to Gas welded samples

b) Effect on Wear Factor

From the results it was observed (figure 3) that at Sliding Velocity of 0.9426m/s, the values of the Wear Factor for TIG welding sample were better than Gas welded sample and Arc welded sample. Also at higher Sliding Velocities (above 1.256 m/s) TIG welding sample was showing better wear factor values compared to the values of Gas welding sample and Arc welding sample even though all these values were observed to be very close. Further at higher sliding velocities of 1.571 m/s, Gas welding samples were showing slightly better values of wear factor compared to Arc welding up to sliding distances of 1500 m. At still higher sliding distances higher than 1500 m, the Arc welded samples were showing better Wear Factor values compared to Gas welded samples.

c) Effect on Friction Coefficient

From the results it was observed (figure 4) that at Sliding Velocity of 0.9426m/s, the values of the Friction Coefficient for TIG welding sample were better than Gas welded sample and Arc welded sample. However the Friction Coefficient values of Gas welded samples and Arc welded samples were enhanced compared to TIG Welding samples at higher sliding velocities of above 1.256 m/s. Also it was observed that at higher sliding velocities of 1.571 m/s, Gas welding samples were showing slightly higher values of Friction coefficient compared to Arc welding up to sliding distances of 1500 m. At still higher sliding distances higher than 1500 m, the Arc welded samples were showing higher Friction coefficient values compared to Gas welded samples.

d) SEM Micro Photographs

Scanning Electron Microscopy, which is one of the conventional characterization techniques, was employed to study the nature of the wear surface of the welded samples. Micro photographs at 50x, 200x, 400x magnifications were taken. Few sample photographs are shown in figure 5 and 6.

It can be clearly observed from figures 5 and 6 that at Sliding Velocities (above 1.256 m/s) the Gas welding Sample and Arc welding sample show deeper plough marks and TIG welding sample show small chips and particles, showing that TIG welding sample has better wear properties compared to Gas welding sample and Arc welding sample. However at higher sliding velocities of 1.571 m/s, TIG welding samples show deeper plough marks with delimitation compared to Gas welded samples and Arc welded samples. Hence the wear properties of Gas welded samples and Arc welded samples at higher sliding velocities of 1.571 m/s were seen enhanced compared to TIG welding samples. Hence the SEM microphotographs also support the discussion in the previous sections.

e) Result Agreement with earlier researchers

The results obtained are in close agreement with the earlier researchers who have compared different welding processes using AHP (Analytic Hierarchy Process Model) based on quantitative and qualitative factors, [Balasubramanian *et al.,*(2009)]. In their research it has been concluded that, based on both quantitative and qualitative factors, an integrated process measure (PM) for TIG welding was 0.2150 among the different processes to hard face carbon steels. The values of integrated process measure for other processes are lesser than TIG welding except PTAW. Conventional weld hard facing is done by Oxy-fuel welding, gas tungsten arc welding (GTAW/TIG), gas metal arc welding (GMAW/MIG), shielded metal arc welding (SMAW), and flux cored arc welding (FCAW) processes. Percentage dilution plays a major role in determining the properties of a hard-faced surface [Gourd LM (1998)]. Dilution is defined as the percentage of base metal in the weld metal deposit. If the percentage of dilution is high, then the percentage of base metal in the weld metal deposit will be high and vice versa. At a higher percentage of dilution level, the surface properties are not enhanced to the expected level because of the presence of a higher amount of base metal. On the other hand, at a lower percentage of dilution level, the surface properties are much better compared to the base metal because of a low percentage of base metal in the deposited weld metal. Hence, the welding process which produces a low percentage of dilution is generally preferred for hard facing applications [Marimuthu *et al.,* (2003)]. The dilution factors for various processes are given below [Product Reference Manual – AFROX – Section -12]:

Welding Process	Dilution Factors
Oxy-Acetylene Gas Welding	0 - 5 % Dilution
TIG Welding	5 - 15 % Dilution
Shielded Metal Arc Welding	20 - 45 % Dilution
Flux Cored Wire Arc Welding	20 - 45 % Dilution
Submerged Arc	25 - 50 % Dilution

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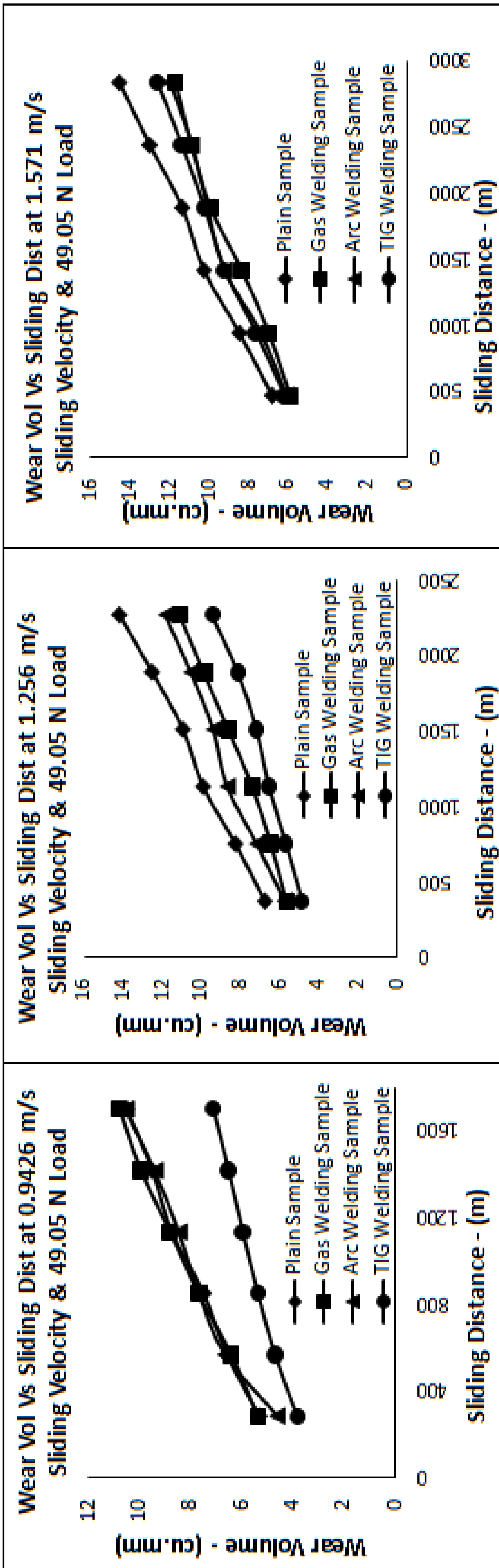


Fig. 2 : Effect of Welding process on Wear Volume at various sliding distances and loading conditions

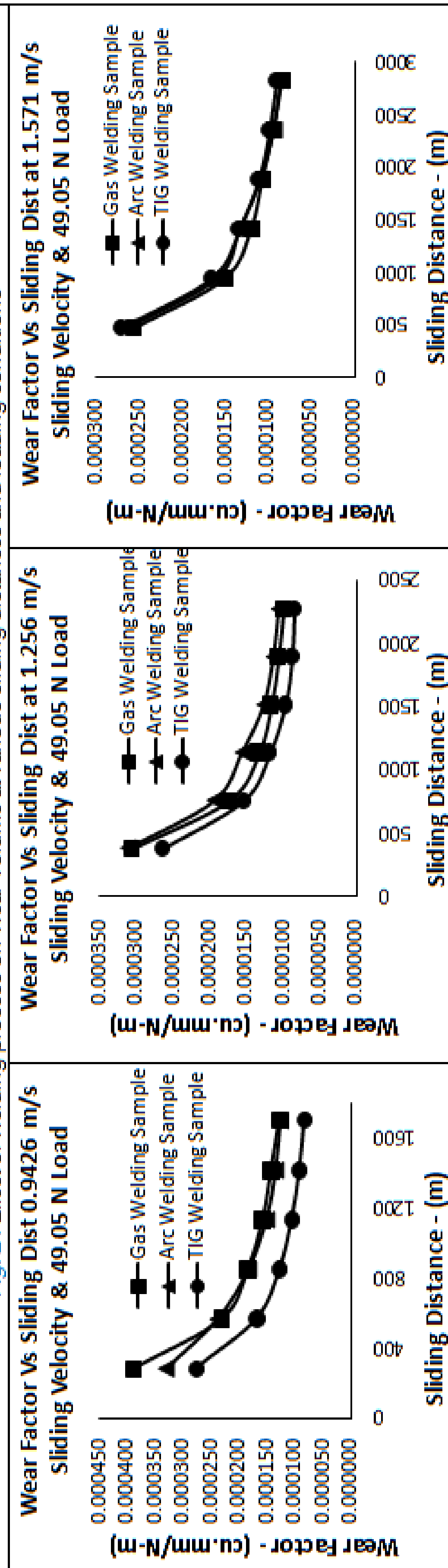


Fig. 3 : Effect of Welding process on Wear Factor at various sliding distances and loading conditions

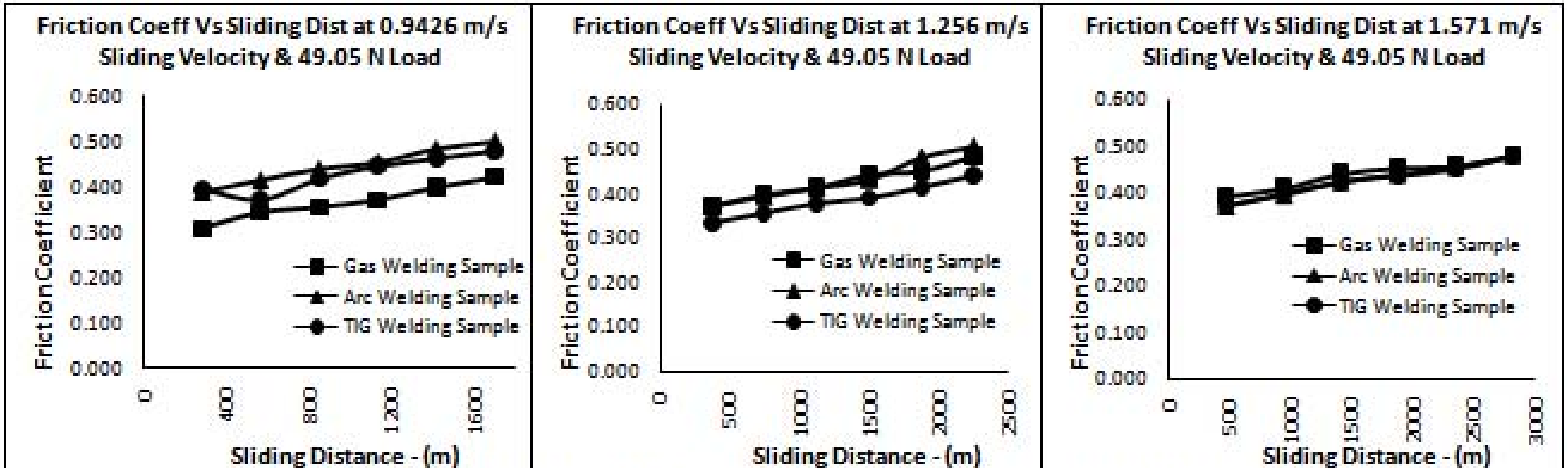
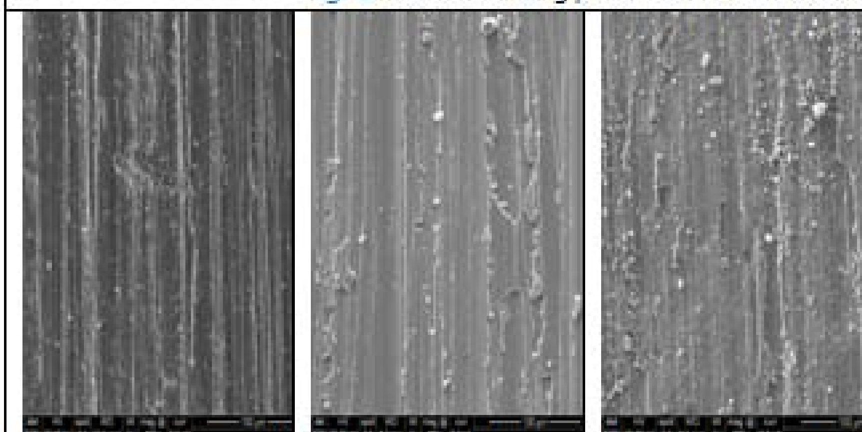
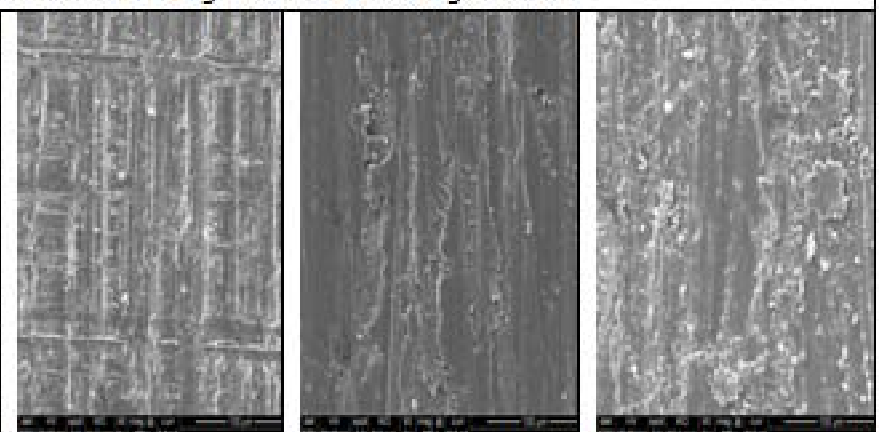


Fig. 4 : Effect of Welding process on Friction Coefficient at various sliding distances and loading conditions



Gas Weld Sample at 1.256 m/s Sliding Velocity, Load 49.05 N	Arc Weld Sample at 1.256 m/s Sliding Velocity, Load 49.05 N	TIG Weld Sample at 1.256 m/s Sliding Velocity, Load 49.05 N

Fig. 5 : SEM Micro Photographs at 400x Magnification



Gas Weld Sample at 1.571 m/s Sliding Velocity, Load 49.05 N	Arc Weld Sample at 1.571 m/s Sliding Velocity, Load 49.05 N	TIG Weld Sample at 1.571 m/s Sliding Velocity, Load 49.05 N

Fig. 6 : SEM Micro Photographs at 400x Magnification

VI. Conclusions

1. TIG welding samples were showing better wear properties until a sliding velocity of 1.256 m/s with various sliding distances and loads, compared to Gas welding samples and Arc welding samples.
2. Gas Welding samples and Arc Welding samples yielded better wear properties at higher sliding velocities above 1.571 m/s with various sliding distances and various loads compared to TIG Welded Samples.
3. Arc Welding samples were showing better wear properties than Gas welding samples at higher sliding velocities above 1.571 m/s and at higher sliding distances higher than 1500 m.

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Development of a Tool for Programming the Machining Instructions in a CAM Environment

By Rahou M, Sebaa F.

Abstract - The objective of this paper is the develeppement a tool for programming the machining instructions in a CAM environment. To help the NC programming of all addresses, it was developed a module contributing to the adaptation of CN addresses for different languages FANUC, FAGOR, NUM, SINUMERIK and EIA, turning and milling. This module serves several functions. The first function is to seek designation of preparatory functions after selecting the command "/ operation" and "G-code" and the auxiliary functions. The second function allows the identification of all NC addresses with writing syntax desired codes. The third function is to automate the calculation of various parameters of cutting. The fourth function is devoted to the simulation programs.

Keywords : CAM, Tool, programming, here.

GJRE-A Classification : FOR Code: 091004

DEVELOPMENT OF A TOOL FOR PROGRAMMING THE MACHINING INSTRUCTIONS IN A CAM ENVIRONMENT

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I. Introduction

The programming of CNC based on standard programming languages. It turns out that these standards are not complete. The directors of CNC (DNC) to adapt the specifications of their machines. The standards describe programming languages also called commands. Each builder DNC trying by all means to differentiate its products from those of competition, and develop the standard programming languages [1].

The program content is developed with reference to the ISO standard for machine language frequently in control manager regarding the specificities of each manufacturer DNC. Since each manufacturer control manager tries by all means to differentiate its products from those of the competition and develops programming languages standard FANUC SINUMERIK, NUM, SIEMENS, PHILIPS, BOSCH, FAGOR, MAZOL, .

A set of tutorials enabling the discovery and language learning machine was developed highlighting some functions preparatory core and CNC technology. We can quote EMCO, DENFORD, PROCAM, Tour Assistance, the ARDEM (Association for Research and Development Multimedia Computer Education) who developed three tutorials (CONCEPT CN CN DIDA, IPMO), the association MECAPASSION, DS, SOLIDCONCEPTER software provides several commands, using the operator command is equivalent to choosing the post desired processor. Orders and REALMECA FAGOR offer intuitive tools to machines, using a group technology based on statements of form (dot machining operations). Other work has been developed to provide the learner the basics of CNC programming, but limited to one language [2].

This work aims to study the incompatibility of NC commands the most used and the development of a tool for NC programming in a CAM environment.

II. Incompatibilities Address

The most common standard is the ISO standard (ISO 840) which defines the alphabet based on the ASCII code and additional standards that define the programming format (ISO 1056, 1057, 1058, 1059, 2539) [3].

Table 1 shows some differences in codes with two names for the same code [4,7].

Table 1 : Incompatibility of codes based on a designation

Codes	Turning	Milling
G76	Threading cycle	bore
G90	Removal cycle	absolute programming
G92	Threading cycle	absolute programming
G94	Face turning cycle	Feed (minute)
G98	Feed (minute)	Return to starting point

Some manufacturers of DNC (FANUC, FAGOR) use the same code in turning and milling for two different designations such as for Fanuc and different codes for the same designation. These differences are even more pronounced in the case of FAGOR. To the SINUMERIK, the same codes are generally used for the same designations. As for the NUM control, using the ISO code, there have been no differences in designation for the same code.

With the exception of preparatory functions and auxiliary functions, the result after the statistical study of these addresses the following [5, 10]:

-37.50% use the same designation

-25% use two names

-08.33% use three designations

-08.33% use four designations

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-08.33% use five names (addresses Q, H)

-04.16% use seven nominations (address P)

-04.16% use eight nominations (Address R)

-04.16% use nine nominations (e-K)

Faced with a likely lack of consultation and a fierce business competition, it continues to see a non-uniformity of language difficulties caused by the programming of CNC [6]. Hence the importance of developing a tool for NC programming for different orders.

III. Statistical Study On Nc Addresses

The programming of CNC machines based on standard programming commands. These standards are incomplete. Builders directors CNC fit the specifications of their machines.

NF standards (ISO 6983-1) (NF Z68-037), NF [ISO 4342] describe programming languages [8]. These are inconsistencies despite numerous standardization efforts.

Figure 1 shows a general representation of incompatibilities NC addresses for different commands studied [10] .

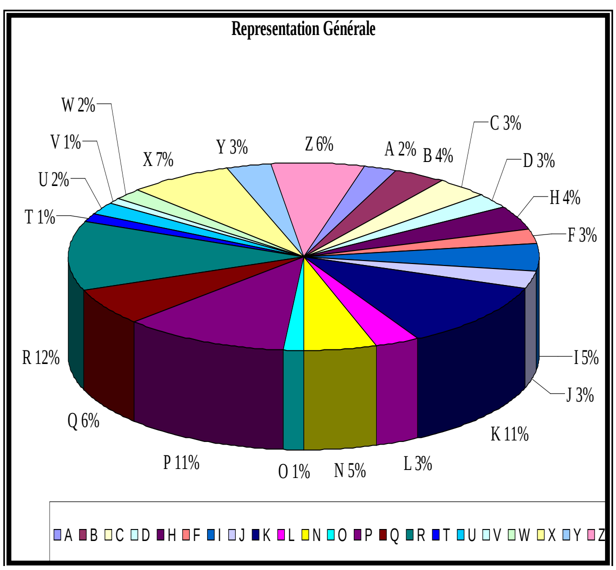

Figure 1 : The statistical incompatibilities

IV. Tool Developed

To overcome the problems posed by these inconsistencies, contributing to an educational module for NC addresses for FANUC SINUMERIK NUM FAGOR in turning and milling commands has been developed.

This tool has several functions, which are:

- Preparation of the workstation (Figure 2);
- Examples of machining operations such as:
  - ✓ Training (Figure 3);
  - ✓ Bore (Figure 4);
  - ✓ Circular interpolation (Figure 5 , 6);
  - ✓ Linear interpolation (Figure 7);
- Designation of preparatory functions after choosing "control / operation" and the "G -code" (Figure 8)
- Designation of auxiliary functions after selecting the "control" (Figure 9);
- Identification of all addresses A to Z (Figure 10);
- Automatic calculation of various cutting parameters (Figure 11, 12)

Figure 2 : 26: Preparing the Workstation

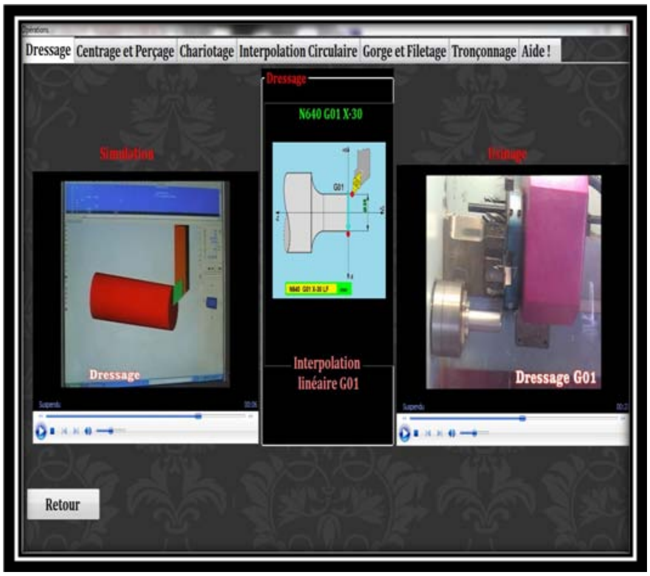

Figure 3 : Example of Training

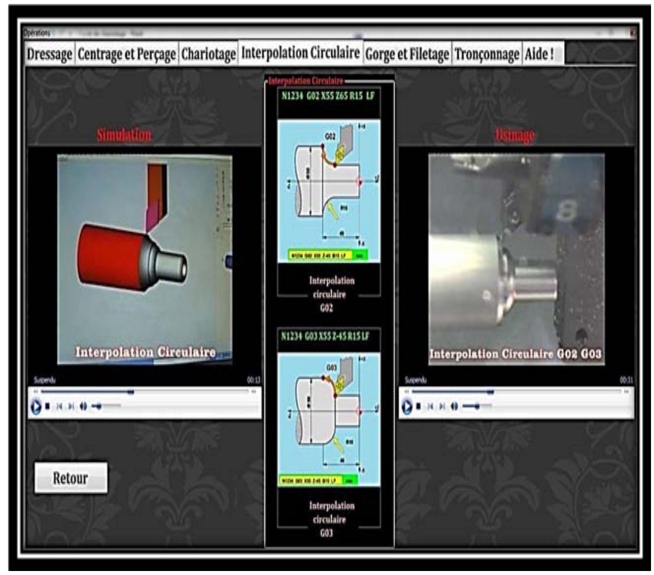

Figure 5 : Example of circular interpolation in turning

Figure 4 : Example of Bore

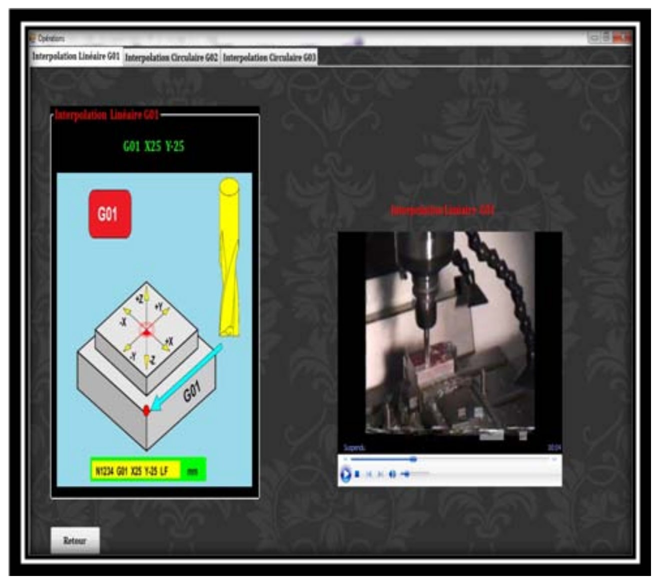

Figure 6 : Example of linear interpolation (G01) in milling

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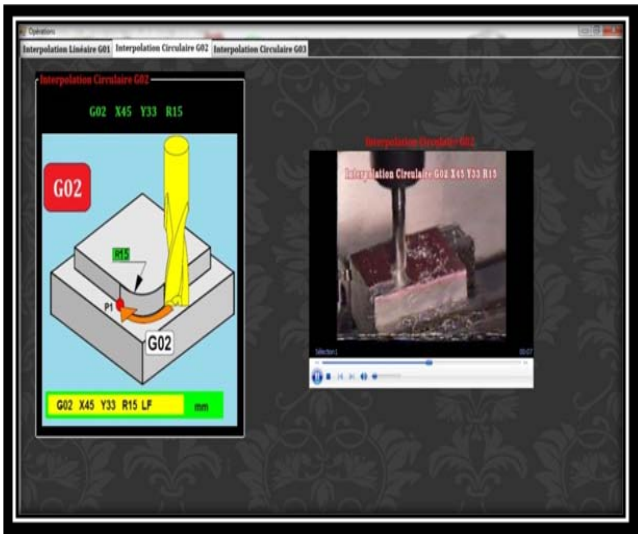

Figure 7 : Example of circular interpolation (G02) in milling

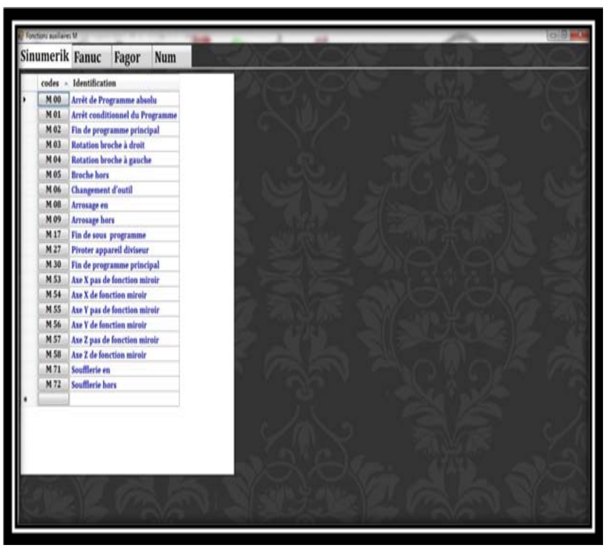

Figure 8 : Identification of G-codes

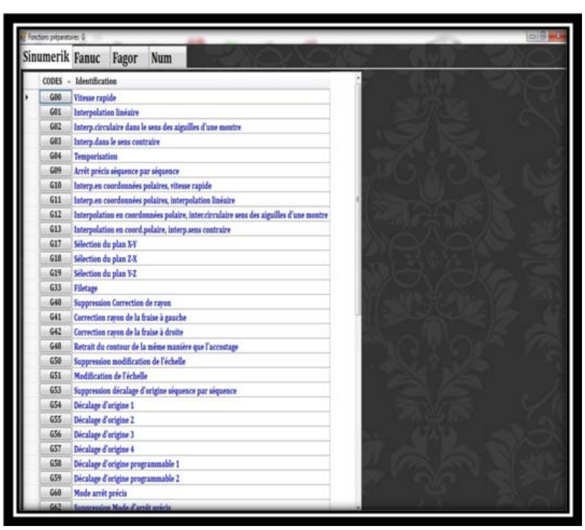

Figure 9 : Identification of M-codes

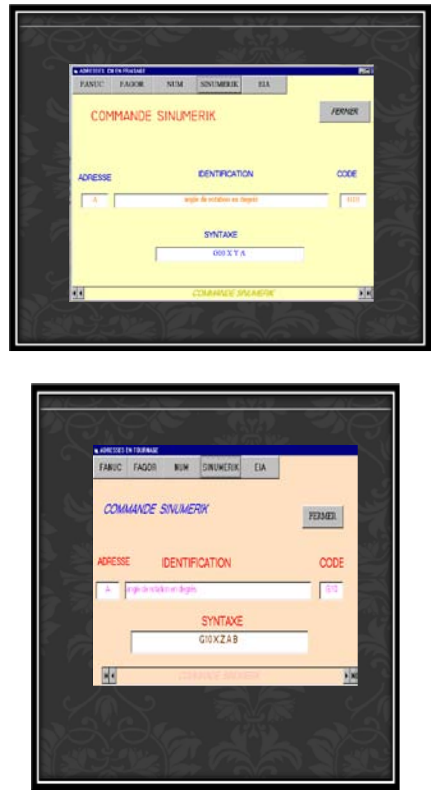

Figure 10 : Examples of identification of CN codes A to Z in turning, milling

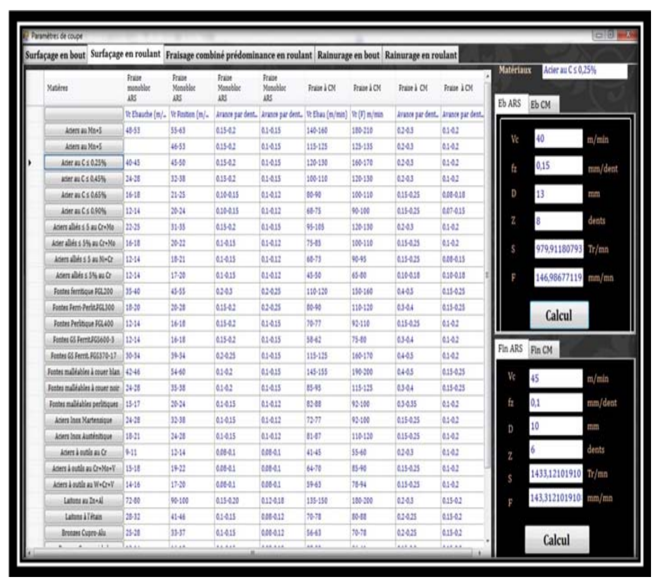

Figure 11: Example of automated calculation of cutting parameters in milling (Surfacing)

Figure 12 : Example of automated calculation of cutting parameters in turning (cutting)

V. Conclusion

A statistical study has been to highlight the differences and incompatibilities between the addresses of the various commands. We find that 62.50% of the addresses using one or two appointments, while the remaining addresses, or 37.50%, using four to nine nominations. This study could be used as a criterion of choice of material depending on the desired goal.

About a third of the addresses do not change regardless of the order designations used. The syntax for writing a block of program database used for the development of an adaptation module of machining instructions

To help the programmer to develop a machining program in different order, a tool was developed. This tool has several functions. The first function is to seek designation of preparatory functions after selecting the command "/ operation" and "G-code" and axillary functions. The second function allows the identification addresses with writing syntax desired codes. The third function processes Automation of various cutting parameters. The fourth function is devoted to the simulation of machining programs.

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FEA of the Forged Steel Crankshaft by Hypermesh

By Rajesh Mallikarjun Madbhavi & Tippa Bhimasankara Rao
Nimra Institute of Science and Technology

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In this study a static analysis is conducted on this crankshaft, with single crankpin of crankshaft. Finite element analysis is performed to obtain the variation of stress magnitude at critical locations. With the help of maximum gas pressure at time of combustion, total load acting on the crankpin of the crankshaft is calculated. In this static analysis of crankshaft, loading and boundary condition depend upon the maximum gas pressure acting on the crankpin. For the FEA analysis of crankshaft we selected the different element length size for the meshing.

Index terms : forging, forging limit diagram (FLD), hyper mesh, simulation, 3d modeling, computational analysis, stress, strain.

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FEA OF THE FORGED STEEL CRANKSHAFT BY HYPERMESH

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Rajesh Mallikarjun Madbhavi [α] & Tippa Bhimasankara Rao [σ]

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For the FEA analysis of crankshaft we selected the different element length size for the meshing. Meshing is done using the HYPERMESH software with the tetra element shape. The static analysis is done analytically. This resulted in the load spectrum applied on crankpin area of crankshaft. This load is applied to the FE model in ANSYS and boundary conditions were applied according to the engine mounting conditions. The analysis is done for maximum loading condition. Finally analytical stress calculated value and ANSYS stress value of crankshaft are verified.

Index terms :forging, forging limit diagram (FLD), hyper mesh, simulation, 3d modeling, computational analysis, stress, strain.

I. Introduction

The Crankshaft

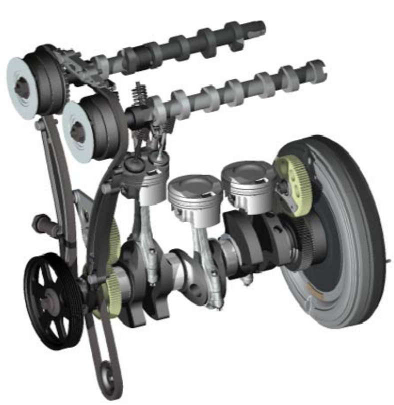

Figure 1 : Functional layout diagram of crankshaft

Author α : PG Student, Department of Mechanical Engineering, Nimra Institute of Science and Technology.
Author σ : HOD, Department of Mechanical Engineering, Nimra Institute of Science and Technology, Vijayawada, AP, India.

The primary function of the crankshaft is to convert the translational mechanical energy of the piston being driven back and forth by the pneumatic energy provided by pressure change as a result of the combustion reaction. Crankshafts are high volume production engine components and their most common application is in an automobile engine. In an internal combustion engine, the reciprocating motion of the piston is linear and is converted into rotary motion through the crankshaft. There are many other applications of a crankshaft which range from small one cylinder engines to very large multi cylinder marine crankshafts. The connection of the piston to the crankshaft via the connector pin provides for the transfer of this energy; the force of the connector pin to the small portion of crankshaft axel that is offset from the main axis causes the rotation about the main crankshaft axis. The crankshaft is also connected to the pull-start by the pull-start connection cup. When the pull-start chord is pulled, the energy is transferred to rotational energy of the crankshaft.

Now that the crankshaft has converted the translational mechanical energy of the piston to rotational mechanical energy, its next function is to transfer this energy to the driver pulley of the pulley-belt system. This is a critical transfer of energy because it is the belt-pulley system that ultimately displaces this rotational mechanical energy to the auger, causing it to rotate and collect the snow and other material that is imported by the auger. The flow that is associated with the crankshaft is just this energy conversion. The crankshaft is located directly adjacent to the two-cycle gas engine, since it is connected to the piston by the connector pin. This location next to the engine is a hot environment that is caused by the convection of thermal energy off of the engine block's heat sink. The high temperatures in this environment are cause for consideration when choosing the material for the crankshaft, which will be discussed in the following section, along with the geometry and appearance of the component.

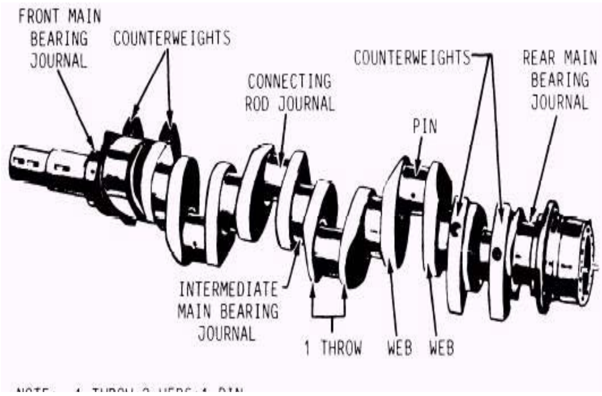

Figure 2 : Basic crankshaft with its nomenclature

II. History

In the past, the crankshaft was developed without using any analytical software's. So, in those days not only crankshaft, but all other products also were developed with doing various kinds of iterations in manufacturing technology. Due to which it affects the total production cost, time consumption & all overall project cost.

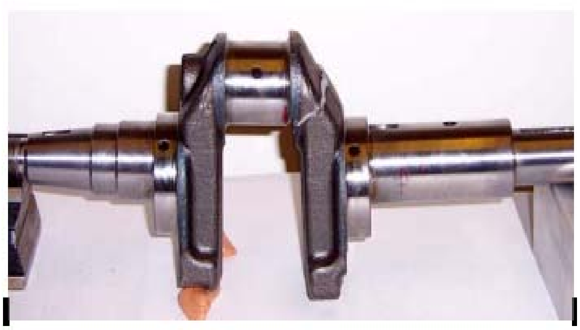

Figure 3 : Failure occurred area of crankshaft (i)

Figure 4 : Failure occurred area of crankshaft (ii)

Figure 5 : Final stage of failure occurred in the crankshaft (iii)

III. Problem Definition

For the FEA analysis of crankshaft we selected the different element length size for the meshing. Meshing is done using the HYPERMESH software. The element type used for crankshaft is solid 3D. For the analysis of crankshaft the tetra element shape is used. The static analysis is done analytically. This resulted in the load spectrum applied on crankpin of crankshaft. This load is applied to the FE model in ANSYS, and boundary conditions were applied according to the engine mounting conditions.

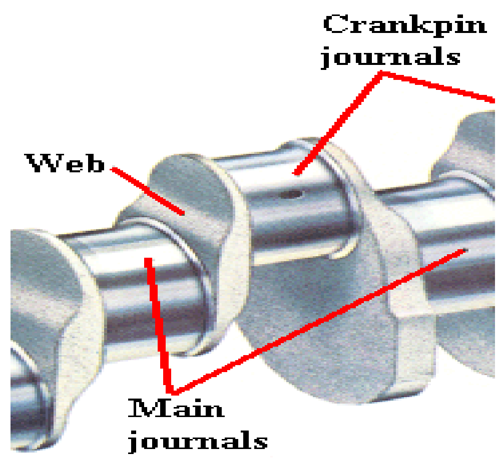

Figure 6 : Introduction of area where failure occurred most probably

Figure 7 : Side view of crankshaft showing changes in its lob shape

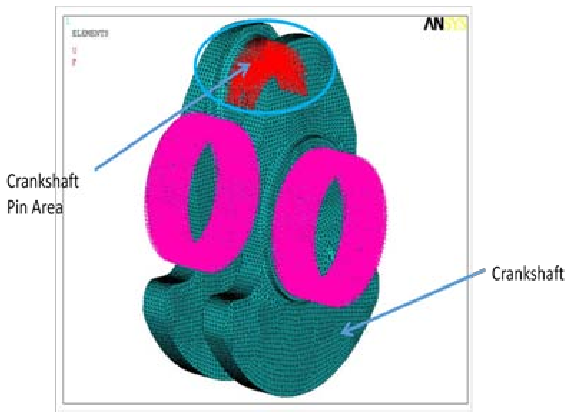

Figure 8 : Stress concentration area of crankshaft showing in hypermesh

IV. Design Calculation by Analytically

In a reciprocating engine, the crankpins, also known as crank journals are the journals of the big end bearings, at the ends of the connecting rods, opposite to the pistons. If the engine has a crankshaft, then the crank pins are the journals of the off-centre bearings of the crankshaft. In a beam engine the single crank pin is mounted on the flywheel. In a steam locomotive the crank pins are often mounted directly on the driving wheels.

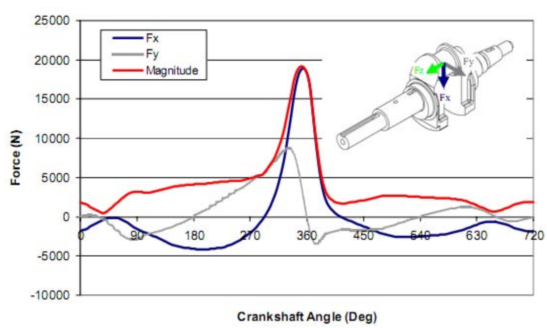

Figure 9 : Forces applied in various directions in crankshaft

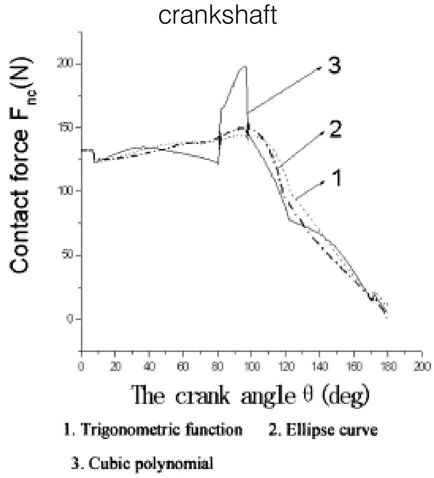

Figure 10 : Graphical analysis of contact forces & diff. crank angles

V. Steps of Simulation for Validation

There are following steps followed for simulation:

i. Exact defining the critical area of load acting on crankshaft.
ii. Load Distribution of crankshaft.
iii. Meshing of crankshaft with different shapes of element.
iv. Graphical analysis for calculating critical load area.
v. Target the area to minimize the load completely (i.e. uniformly distributed).

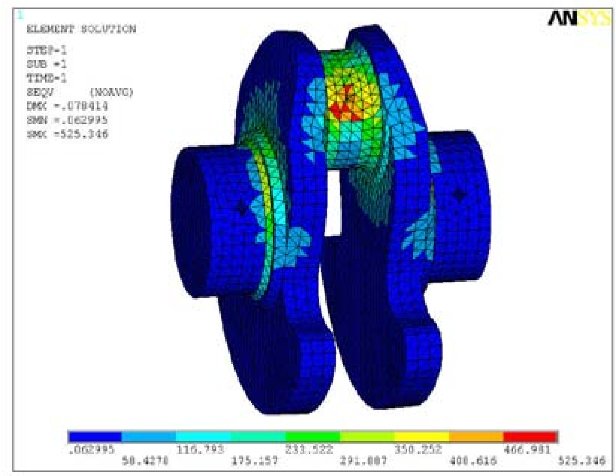

Figure 11 : Meshing of crankshaft with different shapes of elements

a) No. of Iterations with Different Case Studies

There are following case studies applied for simulation:

i. Meshing of crankshaft with triangular shapes of element with considering only bending load.
ii. Meshing of crankshaft with triangular shapes of element with considering only torsional load.
iii. Meshing of crankshaft with tetra shapes of element with considering only bending load.
iv. Meshing of crankshaft with tetra shapes of element with considering only torsional load.
v. Meshing of crankshaft with tetra shapes of element with considering only bending & torsion load.

Finite element analyses of the crankshafts were conducted to obtain stress distributions, determine the critical location of the crankshafts and to determine the stress concentration factors. Based on the finite element analysis performed for the two crankshafts, life predictions were performed using the properties obtained from the strain-controlled specimen fatigue tests. Both the S-N and the strain-life approaches were used, results of which were then compared with the component test data.

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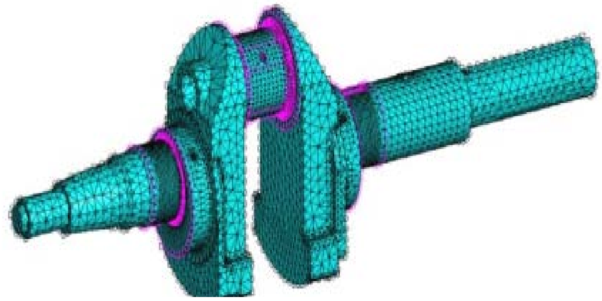

Figure 12 : Meshing of crankshaft with triangular shape of elements

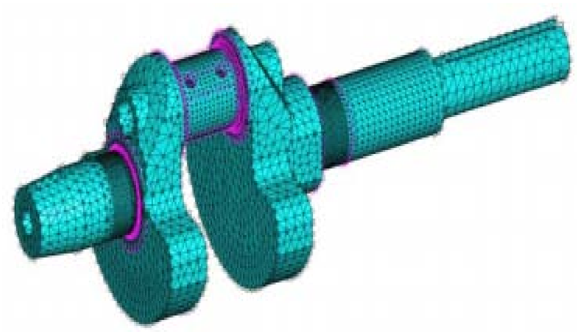

Figure 13 : Meshing of crankshaft with polygonal shape of elements

VI. Experimental Set-up

For specimen testing, strain-controlled monotonic and fatigue tests of specimens made of the forged steel and cast iron crankshafts were conducted. From these experiments, both static as well as baseline cyclic deformation and fatigue properties of both materials were obtained. Such data provide a direct comparison between deformation, fatigue performance, and failure mechanisms of the base materials, without introducing the effects and interaction of complex design parameters such as surface finish, component size, residual stress, stress concentration, etc. ASTM standard test methods and recommended practices were followed in all tests. Charpy V-notch specimen tests were also conducted due to the occasional impact loads applied to the crankshaft.

A number of load-controlled fatigue tests of crankshafts made of forged steel and ductile cast iron were also conducted. Such data provide a direct comparison between fatigue performance of the components made of each base material and manufacturing process. Such comparison inherently includes design effects such as surface finish, component size, residual stress, and stress concentration.

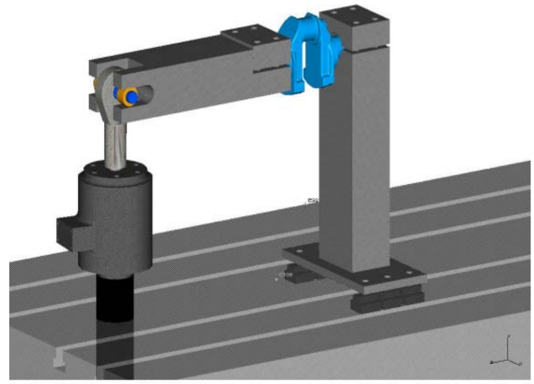

Figure 14 : Experimental set-up diagram (i)

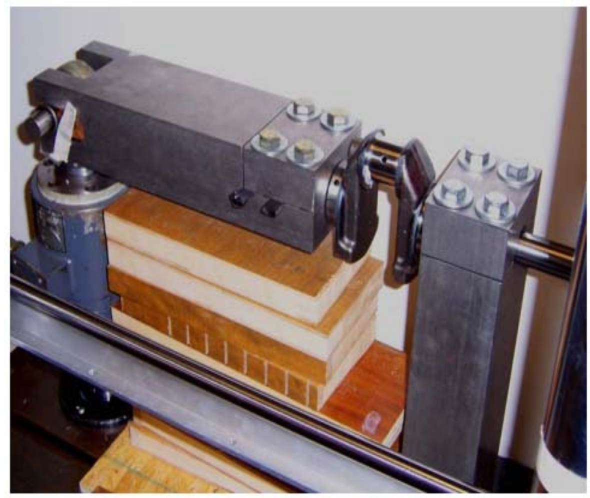

Figure 15 : Experimental set-up diagram (ii)

VII. Result

This section presents the final results for the forming simulations after spring back compensation. Analytical stress calculated value & ANSYS stress value of crankshaft are verified. Maximum stresses are generated on oil hole of the crank pin, fillet area of crankpin and journal bearing surface of the crankshaft.

Finite element analyses of the crankshafts were conducted to obtain stress distributions, determine the critical location of the crankshafts and to determine the stress concentration factors. Based on the finite element analysis performed for the two crankshafts, life predictions were performed using the properties obtained from the strain-controlled specimen fatigue tests. Both the S-N and the strain-life approaches were used, results of which were then compared with the component test data.

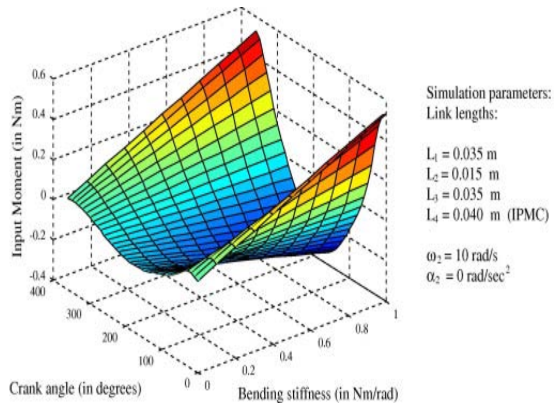

Figure 16 : Simulation result of bending stiffness with diff crank angle at crank pin area

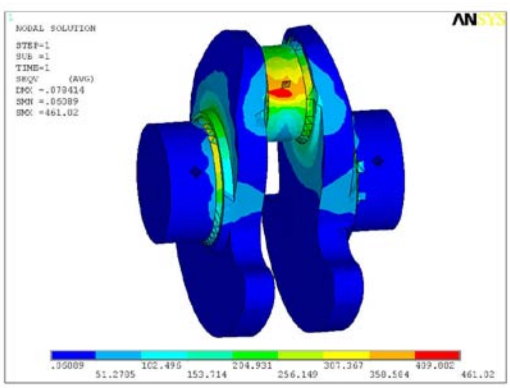

Figure 17 : More stress occurred at crank pin fillet area

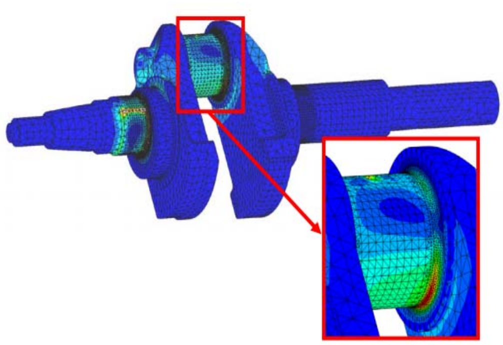

Figure 18 : Minimized stress area at crank pin fillet area

VIII. Conclusion

There are some main conclusions that can be drawn from this project. The main objectives were met and even though the hope was to be able to design the crankshaft with considering torsional & bending load, we finally reached a feasible solution. The main objective was to design the crankshaft and then evaluate if investment in simulation software would be profitable. The answer to the question if this would be profitable, as can be understood from reading the discussion, depends greatly on how We chooses to profligate. If we focus on especially advanced meshing tools, an investment in simulation software would most certainly be profitable in terms of more orders, faster and cheaper production and safer production.

However, if we only produce meshing tools per year, buying product externally, only when necessary, would maybe be a better option. But from a future perspective, one can expect the meshing operations to be even more complicated & software will rise quickly as the demands on the products get higher.

References Références Referencias

Appendix : List of Publications and Presentations on the Study

1. A Literature Review on Durability Evaluation of Crankshafts Including Comparisons of Competing Manufacturing Processes and Cost Analysis, Mehrdad Zoroufi and Ali Fatemi, 26th Forging Industry Technical Conference, Chicago, IL, November 2005.
2. Durability Comparison and Optimization of Forged Steel and Ductile Cast Iron Crankshafts, Jonathan Williams, Farzin Montazersadgh and Ali Fatemi, Great Designs in Steel, Livonia, Michigan, March 7, 2007.
3. Fatigue Performance Comparison and Life Prediction of Forged Steel and Ductile Cast Iron Crankshafts, Jonathan Williams, Farzin Montazersadgh and Ali Fatemi, 27th Forging Industry Technical Conference, Ft. Worth, Texas, March 27, 2007.
4. Fatigue Performance of Forged Steel and Ductile Cast Iron Crankshafts, Jonathan Williams and Ali Fatemi, SAE Technical Paper 2007-01-1001, SAE World Congress 2007, Innovations in Steel Bar Products and Processing, April 17, 2007, Detroit, Michigan.
5. Dynamic Load and Stress Analysis of a Crankshaft, Farzin Montazersadgh and Ali Fatemi, SAE Technical Paper 2007-01-0258, SAE World Congress 2007, New SI Engine and Component Design, April 17, 2007, Detroit, Michigan.
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- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

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3. SUBMISSION OF MANUSCRIPTS

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Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

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Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

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The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

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20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

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26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

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To make a paper clear

· Adhere to recommended page limits

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- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

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· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

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- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
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- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
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Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

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- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

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- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

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- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
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- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
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Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
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- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
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Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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