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Experimental 120cc Mono Cylindrical Design Motor To Analyze Vortex And Multiple Intake Ignition Sites.

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ABSTRACT:

The intent of this study is to design, construct and test cylinder with a hot tub and a variety of ignition sites. Side design uses solid Floworks Works to model airflow inside the head and disc. The calculation of the vortex rate and the volumetric flow rate of the results. It took many attempts at designing the site before finalizing an appropriate design. Once arrived at an appropriate design, it was built using the rapid prototyping printing method known as 3-D (cast-die-casting). Installation of valve guides and seats on the head. And after valves, springs, retainers have been measured to allow testing. The entrance has been created using the stereo print stone because of the closure has a smooth surface and thin walls. A wheel bolt was constructed to measure the transverse rotation of the gas in the cylinder type. The pilot chairman of tests at the University of Miami bank flow in the laboratory of internal combustion engines. The results were compared with experimental work and theoretical modeling. The results closely match. The difference between experimental and theoretical values of high spiral error rates of less than 3% error and cycle ratio of less than 10%. Scenario of low snail, and the error was less than 30%. Measuring the flow velocity of a scenario, the spiral increase of 28.87 CFM and swirl ratio was measured as 2.87. Creating FlowWorks SolidWorks should be accurate results for a high-spiral scenario and more different geometry tests.

INTRODUCTION:

The purpose of this project was to design a cylinder head with variable swirl and variable ignition sites. The test engine is a Honda GX120 single cylinder spark ignited internal combustion engine. It is 120cc and air cooled. This experiment used the CFD modeling tool Floworks; it is embedded in

Solid Works. Floworks was used to optimize the experimental cylinder for swirl and flow rate. The Solid Works Flow Simulation software uses the K-E turbulence model. The software is capable of analyzing internal, external, compressible, incompressible, turbulent, and laminar flow. The software is also capable of heat transfer analysis. It was developed by Mentor Graphics Corporation and can be embedded in most major 3-D modeling programs. As defined by Stone in Introduction to Internal Combustion Engines, swirl is the "ordered rotation of air about the cylinder axis". He mentions that there are two ways to create swirl. The first method is to use a shrouded intake valve so that the direction of the air can be controlled. This is difficult since the valve cannot rotate and often causes wear problems at the valve rocker arm contact point. There is also a large decrease in volumetric efficiency because of the small flow area. The second method is to design the inlet passage to create swirl. There are two port geometries commonly used helical and tangential. This is the concentration of this paper. There are many ways to define swirl. In this paper we will define swirl as the ratio between tangential velocity and vertical velocity of air traveling down the cylinder. This ratio should be directly proportional to angle of inclination of the streamlines. Based on the computer modeled data, the average tangential velocity will be found in the cylinder and compared with the average axial velocity to give the swirl ratio. In order to verify these results, an experimental cylinder head was built and tested on a flow bench. A pin wheel was used to calculate the tangential velocity. In addition to comparing swirl, the flow bench was also used to compare the experimental and the computer model flow rate data. There are three common types of swirl measuring techniques. The pin wheel is employed in this experiment. To construct a pin wheel swirl meter, a small piece of flat material (paddle) is attached to a bearing and allowed to rotate about the axis of the cylinder. The pin wheel is considered to move freely and not impede the flow of gasses. The rotational velocity of the pin wheel is used to calculate the velocity of the rotating gasses. Typically, measurements are take at 1 to 1.5 bore diameters down the cylinder. Another similar technique is to remove the paddle and place a honeycomb air straightener in its place. This is usually called an impulse swirl meter (Heywood). The torque exerted on the air straightener is used to determine the angular momentum of the rotating gasses. The third technique utilizes a laser anemometer to measure velocity and angle of flow. This technique is the most costly and requires averaging of data which can produce errors. The advantage of swirl is that it increases burning rate, which decreases knock and increases homogeneity of mixtures. This is especially important at low operating speeds. Swirl and other gas motions create small scale turbulence during compression and combustion. This small scale turbulence is directly related to flame speed (Pozniak, 1985). As stated by Pozniak, "turbulence intensity should be proportional to the square root of dissipated swirl energy". Squish is an additional method to create turbulence during the combustion process. Swirl is generally considered to create more turbulence than squish. Squish is caused by creating a narrow area between the piston and head when at top dead center (TDC) that pushes gasses into the main combustion area. Squish causes increased un-burnt hydrocarbons. The amount of squish area in this design was determined by the restrictions imposed by swirl generation.

SIMULATION:

As discussed earlier, the computer modeling for this thesis used Solid Works Floworks. Mesh generation was accomplished utilizing the methods provided by the software. The remainder of this chapter will discuss different iterations that eventually determined the final design of the cylinder head. The static pressure difference between the inlet and the outlet used in all iterations was 28 inches of water(6.97 kPa). These pressures were considered to be static and all walls were modeled as real walls in the solver. The valve lift was .200" (5.08mm). The original design intent was to use two intake ports. One intake port would create swirl while the other would reduce the swirl. It was decided to begin the design process with the swirl port. The intake port in the original cylinder head was round, entering horizontally smoothly turning downward into the cylinder. The initial swirl port results can be seen in figure 1. A close up of the valve can be seen in figure 2. In figure 3 there is a bottom view of the cylinder. It is possible to see from this view that there is virtually no swirl developed. The bottom view shows the streamlines exiting around the valve and no noticeable swirl occurs. The flow rate through the head in the first iteration is 25.1 CFM and the swirl ratio was measured at .31.

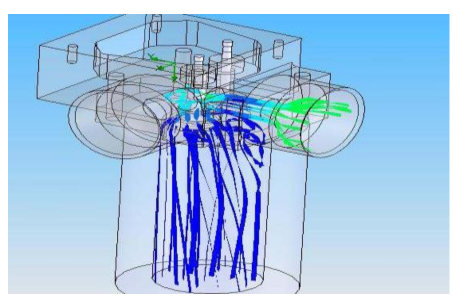

Figure 1- Iteration 1 - Isometric View

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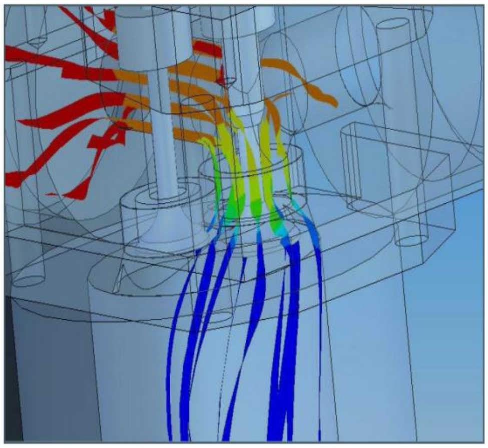

Figure 2 Iteration 1 - Valve View

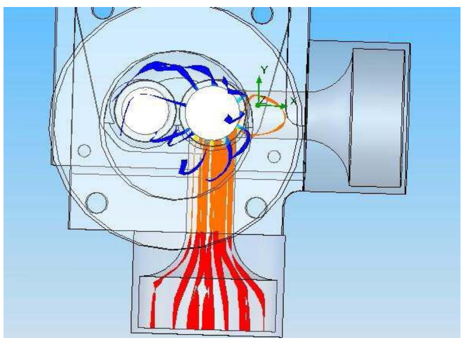

Figure 3 Iteration 1 - Bottom View

For the second iteration, a design from a production engine was copied. As a basis for this design, the cylinder head from the 4.6L Ford 4-valve modular V-8 was used. When one of the intake valves is deactivated during low RPM operation swirl is produced. When both intake valves are activated during high RPM, operation swirl is dramatically reduced. The use of both intake valves at high RPM is to increase volumetric efficiency and therefore, power. For this study, the original Honda 120cc engine utilized two valves, not four valves. This removed the option of deactivating one intake valve to produce swirl. The use of two intake valves increases engine cost substantially. In the Ford engine, the swirl port is elevated around 35 degree

The previous design did not create sufficient swirl. The third iteration would be similar, but the port would be half as tall With this design there is more rotational flow, but the rotation is still not about the axis of the cylinder. The swirl pattern can be seen closer in figure 8. Even though the port that would be used to reduce swirl was closed off, its geometry could interfere with the generation of swirl. The flow rate for the third iteration was calculated as 10.5 CFM and the swirl ratio increased to .88. In the fourth iteration, the swirl reducing port was removed so that it would not interfere with the generation of swirl

Experimental Setup:

Since most of the design work was done in SolidWorks, this design did not require many mechanical iterations. The first prototype was build from SLA (stereo lithography). The goal of this first prototype was to verify the fit of the cylinder head. It also was important in that it allowed for easier visualization of possible iterations that are difficult when trying to view a 2D computer screen. A UV curing laser is used to harden light sensitive liquid polymer. This is the basic technology behind SLA. A stationary laser is redirected via mirrors to harden the surface of the liquid polymer. The initial surface is close enough to a platform that is parallel to the liquid surface, so that the hardened polymer bonds to the surface and build the initial layer. Then, the platform is lowered and another layer is formed by the laser and is bonded to the previous layer. This is repeated until a series of layers form a 3D part. Since there is no support by liquid underneath, cantilevered pieces of parts support structure is required. It is built by the model maker in a post-processing program and is created with the same resin and at the same time as the model. The consistency is similar to window screen and is designed to be broken away from the model after completion. After being removed from the SLA machine, the part is required to be rinsed and then post cured in a UV oven. Parts can be created in the matter of hours to days depending on complexity. Setting up the part to be made and operating the machine takes significant skill and attention unlike some other methods. The accuracy of SLA is one of the highest of rapid prototyping methods. The model can only be made out of one type of material and are limited to photosensitive polymers. Parts are often brittle and affected negatively by high humidity. Materials can be made clear, but are usually opaque. For added strength, parts can be nickel coated, making them stronger.

CONCLUSION:

The results of the high swirl scenario were extremely close. The swirl was measured at ½ a cylinder bore from the head surface. Other experiments usually measure the swirl at 1.0 to 1.5 bore diameters below the head gasket surface, however half the cylinder bore was chosen for computer model variation. Since this head used a helical port swirl developed immediately after exiting the valve and does not rely on valve shrouding or combustion chamber design, swirl developed extremely close to the head and would only decrease as it moved farther down the cylinder Despite the inaccuracy of the low swirl case, the high swirl experimental flow rate was 28.87 CFM while the theoretical results were 29.71 CFM. The swirl ratio for the experimental was 2.87 as compared to 2.59 for the theoretical. These results are all within 10% or less, which shows good correlation. Since these comparisons are for helical ports, we can conclude that SolidWorks Floworks can be used to help design helical ports and combustion chambers. Future work should investigate the surface roughness of the swirl reducing orifices in the prototype cylinder head as this may affect the experimentally determined swirl reduction

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rate. Further work will be needed to prove the accuracy of the software with more complex designs, such as shrouded valves and complex combustion chambers.

REFERENCE:

- Heywood, John B. Internal Combustion Engine Fundamentals. NYC, McGraw-Hill: 1988.
- Lilly, L.R.C. Diesel Engine Reference Book. London, Butterworths: 1984.
- Pozniak, D. , Rydzewski, J. “A Study of In-Cylinder Air Motion in the General Motors Vortec 4.3L, V-6 Engine” Detroit, SAE: 1985.
- Pulkrabek, W. Engineering Fundamentals of the Internal Combustion Engine. Upper Saddle River, N.J: Prentice Hall, 1997.
- Stone, R. Introduction to Internal Combustion Engines. Warrendale, Pa, SAE: 1999.