ABSTRACT

The fuel efficiency of small engines is typically restricted by the use of carburetors. Gasoline Direct Injection (GDi) is an alternative which directly injects fuel into the combustion chamber, resulting in increased fuel combustion and efficiency. This project aimed to modify the cylinder head of a small engine to accommodate an in-cylinder fuel injector. The fuel efficiency of a small, carbureted engine was measured as a benchmark. An injection point was chosen and the cylinder head was modified accordingly.

ABOUT DIRECT INJECTION

Gasoline Direct Injection is a cutting edge alternative to traditional fuel intake in internal combustion engines. In the small engine market, carburetion is the standard intake method. Carburetors mix fuel and air before being it is drawn into the cylinder. Though a simple design, a significant fraction of this mixture is not combusted and therefore wasted. With GDi, fuel is injected directly into the cylinder during the compression stroke. Using this method, the fuel can be concentrated closer to the spark plug, ensuring almost all fuel will combust. This allows for stratified charge combustion, or ultra lean burn, meaning there is a much higher air to fuel ratio (up to 65:1, compared to about 14:1 with carburetion) [1]. As a result, GDi engines will have greater output power per unit volume of fuel, and lower emissions. GDi is still a developing technology and therefore is not mainstream in the small engine market. However, GDi could have great potential with many applications.

DESIGN OBJECTIVE

The purpose of the GDi cylinder head is to create a platform to implement a direct in-cylinder fuel injection system onto the engine with the ultimate goal of increasing fuel efficiency. The objective of the design is to maintain original geometries, while creating an injection point that will allow for optimal fluid flow and combustion.

CONCLUSION

Through benchmarking of a stock, carbureted engine, baseline fuel efficiency measurements were obtained to evaluate the effectiveness of GDi. A prototype cylinder head was manufactured to allow for the implementation of a GDi system. Implementation of this cylinder head in conjunction with an appropriate fuel injector will fulfill the design objective by increasing the fuel efficiency of the engine.

ACKNOWLEDGMENTS / REFERENCES

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FUEL CONSUMPTION ANALYSIS

<table>
<thead>
<tr>
<th>Test</th>
<th>Avg RPM</th>
<th>Mass Before (g)</th>
<th>Mass After (g)</th>
<th>Mass Consumed (g)</th>
<th>Mass Flow (g/min)</th>
<th>Flow Rate (mL/min)</th>
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</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>2750</td>
<td>119.33</td>
<td>98.12</td>
<td>21.21</td>
<td>4.24</td>
<td>6.24</td>
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<td>Test 5</td>
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<td>152.68</td>
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<td>4.40</td>
<td>6.48</td>
</tr>
</tbody>
</table>

Fuel Density: 688 g/L

Time (minute): 5

Figure 1. [1]

Figure 2. Solidworks model of GDi cylinder head

Figure 3. Prototype manufacturing progression