



## Experimental Analysis of Pneumatic Vehicle : A Literature review

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**ABSTRACT :** Present scenario of the world describes, the crisis of fuel and pollution problem, along with it, conventional sources are about to deplete in near years. So, the search on alternative fuels is on progress and in demand too. Today there are several solutions to meet demand for better economy in fuel and one of them is the concept of pneumatic-hybrids. The project focuses on a hybrid-vehicle driven by air as alternate source to fuel and a battery driven too, to reduce the dependency on conventional sources. In this, compressed air is stored in storage tank & pneumatic motor is used for conversion of pressure to mechanical energy. This pneumatic-hybrid vehicle is not only eco-friendly, pollution free but also very economical.

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**Keywords:** Fuel crisis, compressed air, battery operated, pneumatic vehicle.

### 1. Introduction

About a century ago, major source of energy was fossil fuels (hydrocarbons). Technology led a greater use of these fuels, making civilization vulnerable. Society at present totally relies to great extent on different means of transportation. The study made during year 2004, predicts that if oil is consumed at current rates, then by 2020, 80% of the entire non-renewable resource will be consumed. In recent years the awareness of the effect of pollution on nature has increased. Exhaust emissions are getting more and more stringent and there now, exists a discussion about the introduction of a mandatory emissions standard for CO<sub>2</sub>, a green house gas that contributes to the climate change which is major issue of global warming. Today there exist various solutions to achieve emissions and better fuel economy. Some examples of such solutions are VVA (Variable Valve Actuation), EGR (Exhaust Gas Recirculation), direct injection, hybridization of vehicles, just to mention a few.

In our project work, more emphasis has been put on vehicle-hybridization, which can be done in various ways. Along-with pneumatics, electric hybridization is used, in-order to reduce the fuel consumption by taking advantage of the otherwise lost brake energy. This introduces extra manufacturing costs which are compensated by a higher end-product price comparable to the price of high end vehicles. However, it should be remembered that high cost will decrease as the sales volume of hybrid vehicles increase. One way of keeping the cost as low as possible and thereby, increase customer attractiveness is, introduction of Pneumatic hybrid.

### 2. Objective

The main objective of this project is to reduce the dependency on fossil-fuels, also they produce pollutants such as CO<sub>2</sub>, CO, NO<sub>x</sub>, SO<sub>x</sub> which are harmful to human beings and produce effects such as cancer,

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## Nomenclature

HEV	Hybrid Electric Vehicle
IMEP	Indicated Mean Effective Pressure
PHV	Pneumatic Hybrid Vehicle
VVT	Variable Valve Timing

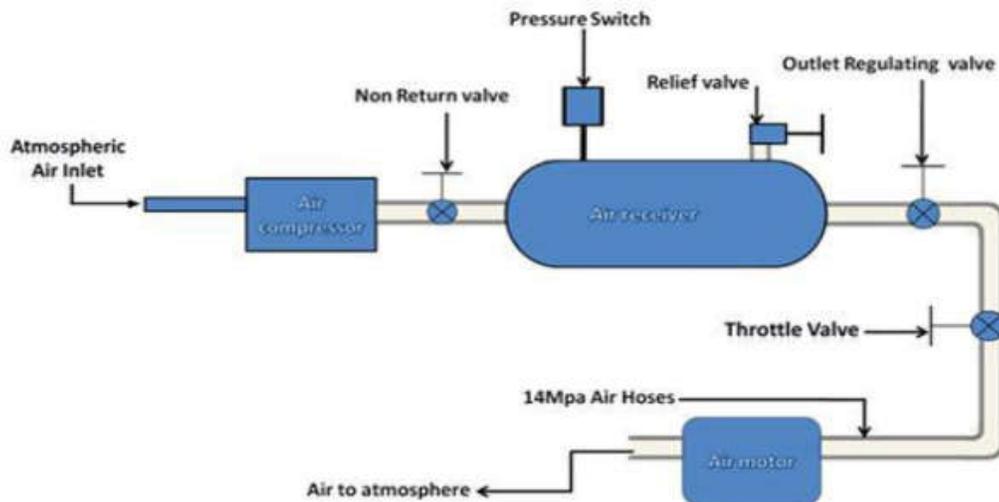
headache, etc. Here, development of pneumatic vehicle using compressed air is main objective and to study its different modes of operation.

The objective was to more thoroughly investigate the different parameters affecting performance characters of pneumatic hybrid engine and to reduce fuel consumption for a pneumatic hybrid vehicle.

## 3. Authors review

### 3.1. Pneumatic Vehicle Using Compressed Air: A Real Solution to Pollution and Fuel Crisis

**N.A. Todkar et. al. [1]** the technology of compressed air vehicles is not new. In fact, it has been around for years. Compressed air technology allows engines/ motors that are both nonpolluting and economical. We designed 3 wheeled vehicle in order to reduce weight. Unlike conventional transmission systems which include clutch, counter shaft, fly wheel, propeller shaft, differential, the pneumatic motor has been connected and coupled to the rear wheel with the use of an intermediate gear box reducing transmission losses and weight of the vehicle. It also occupies lesser space compared to a four wheeler. But in-depth research is required to completely prove this technology for its commercial as well as technical viability.



### 3.2. Design and Development of Pneumatic Hybrid Vehicle (PHV)

**Franco Antony et. al. [2]** For working of an air engine two stroke engine technologies is needed. But the market is now dominated with four stroke engines. So in our project we took a four stroke petrol engine and with some modifications made it into a two stroke air engine. The engine camshaft rotates once for every two rotations of flywheel. For a two stroke it needs one rotation of camshaft for a rotation of the flywheel and for that there must be opening of both inlet and exhaust valves.

Alteration of the cam profile with double cam means, for one rotation of camshaft the both valves will open twice. This is done because in a four stroke engine, for two flywheel rotation the camshaft rotates once. So we modify cam profile so that two lift is possible for both inlet and the exhaust sides. Thus for first quarter of a rotation of the camshaft we get power stroke, next quarter exhaust, third quarter again power stroke and fourth again exhaust. This design is adopted by here since there will be no further modifications required in timing gears and cylinder head is needed to accommodate the design. Thus only work to be done is reduced to cam profile.

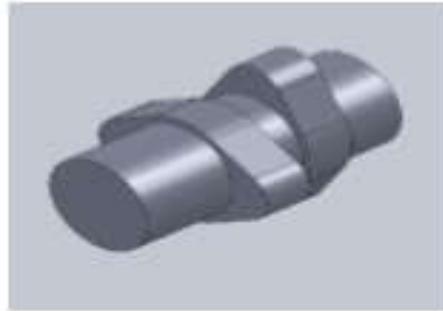


Fig.5Cam Modified

**S. S. Verma S.L.I.E.T., Longowal et. Al.[3]** introduce to the latest developments of a compressed-air vehicle along with an introduction to various problems associated with the technology and their solution. Compressed air as a source of energy in different uses in general and as a nonpolluting fuel in compressed air vehicles has attracted scientists and engineers for centuries.

**Dr. S.S. Thipse et.al.[4]** describes the development of compressed air engine. MDI is one company that holds the international patents for the compressed air engine. . Although it seems to be an environmentally-friendly solution, one must consider its well to wheel efficiency.

**B. R. Singh et.al.[5]** studied about alternative fuel for automobile engines with a special emphasis on compressed air driven engine. In view of the enormous potential of air as working fluid an engine is being designed to run on compressed air

**Saurabh Pathak, Kontham Swetha et.al.[6]** states the effective application of pneumatic power. Pneumatic vehicle will replace the battery operated vehicles used in industries. Pneumatic powered vehicle requires very less time for refueling as compared to battery operated vehicle. On the whole, the technology is just about modifying the engine of any regular IC engine vehicle into an Air Powered Engine

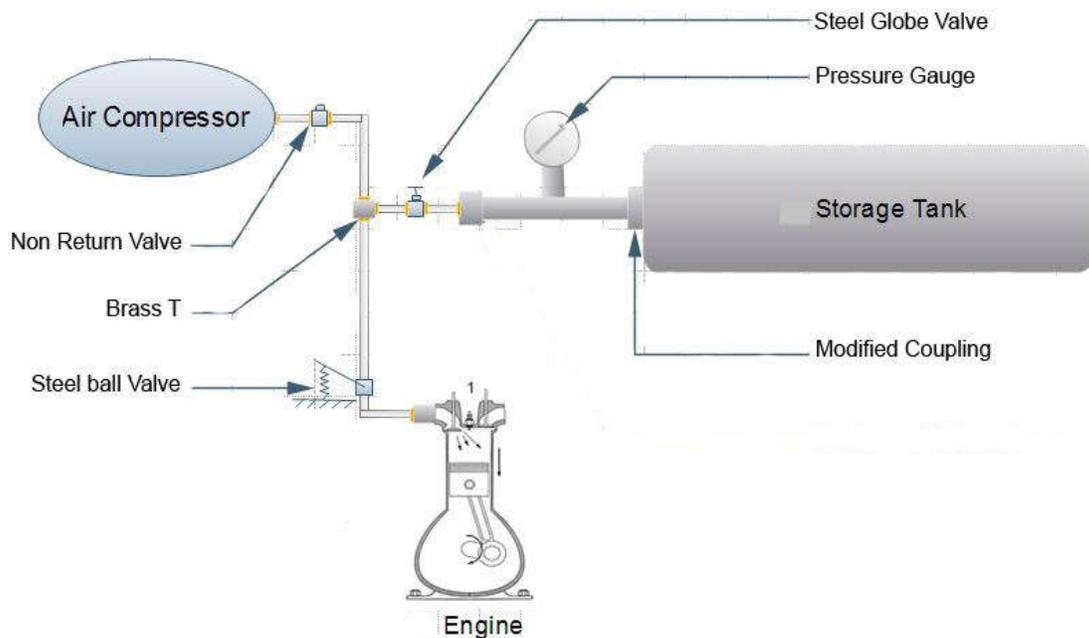
**S.S. Verma et.al.[7]** briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles. Compressed air for vehicle propulsion has already being explored and nowadays air powered vehicles are mostly being developed as a more fuel-efficient means of transportation.

**D.Ravi et.al.[8]** analyzed the Climate change and energy security requires a small reduction in travel demand, model shift and technological innovations in the transport sector. . Through a series of press releases and demonstrations, a car using energy stored in the form of compressed air produced by its compressor has been marked as an environmental friendly vehicle of the future.

#### 4. Objective

The main objective of this project is to reduce the dependency on fossil-fuels, also they produce pollutants such as CO<sub>2</sub>, CO, NO<sub>x</sub>, SO<sub>x</sub> which are harmful to human beings and produce effects such as cancer, headache, etc. Here, development of pneumatic vehicle using compressed air is main objective and to study its different modes of operation. Thus the objective was to have a detailed investigation of the different parameters affecting performance characters of pneumatic hybrid engine and to reduce fuel consumption for a pneumatic hybrid vehicle.

#### 5. Vehicle set-up



#### 6. Components and Materials

**Piston-Cylinder:** A piston can be termed as a component of reciprocating engines and pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. The main function is that the force is transferred from the crankshaft to the piston resulting of compression or ejection of the fluid in the cylinder.

**Pressure regulator:** A pressure regulator is a valve that automatically cuts off the flow of any liquid or gas at a desirable pressure. Mainly they are used to allow high-pressure fluid supply lines or tanks to be reduced to safe and usable pressures for various applications.

**Control Valves:** They are used to control conditions such as flow, pressure, temperature, and liquid level by fully or partially opening or closing in response to signals received from its controllers which compare set points to a process variable whose values are provided by the sensors that monitor changes in such conditions.

**Battery:** Being an eminent supplier and trader of 12V Electric Bike Batteries, they are highly used in various fields like Sightseeing Bus, EV and HEV. These batteries are environment friendly and safe to chargeable. It use for the hybrid vehicle to electric power.

**Air filters:** The MDI engine works with air that is taken from the atmosphere and air pre-compressed in tanks. Air is compressed by the on-board compressor or at service stations which are equipped with a high-pressure compressor. Before compression, filtration of air is needed to get rid of any impurities that could damage the engine. Carbon filters are used to eliminate dirt, humidity, dust and various other particles which, unfortunately, are found in the atmospheric air in our surroundings.

## Conclusion

The pneumatic-hybrid vehicle is one of the treasures to automobile industry. It promises a better combination of different power sources along-with contribution to the field of green technology. The air-hybrids are easy to manufacture and can be easily driven without any carbon footprints. So, for a better tomorrow, pneumatic-hybrid has its role. Thus, for green technology, pneumatic-hybrid is a boon. This achievement is a major break-through in battle to create greener and cheaper motoring. The result is new low-cost pneumatic-hybrid which significantly cuts emission of carbon-dioxide. Existing green-hybrid cars such as Toyota-Prius and Honda-Insight, use petrol engine and braking energy to generate onboard electricity to give supplementary power to the vehicle. Our vehicle uses similar principle, but instead there is no scope of entering of braking energy and can be worked in future. Thus, an efficient greener technology is guaranteed for the future with our project.

## Future Scope

The system eliminates the need for fuel, making the environmental pollution-free. The compressed air drives air motor, which turns the vehicles wheels, once compressed, the air is stored in tank. The air is used when vehicle needs energy, such as for starting up and acceleration. In future we are able to use vehicle with various modifications like increasing tank capacity; using composite materials of high strength; weight of parts like chassis, storage tank, etc, reduces which results in low weight of vehicle; reducing losses of air flow through nozzles, pipes, etc. With above modifications it is possible to increase the performance and distance achieved by vehicle.

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