A Solar based Working Model to Run Air Compressor

V. A. Dahate¹ M. A. Janbandhu² A. G. Bansod³ A. S. Gawai¹ Prof. G. M. Dhoté⁴

¹²³⁴ Department of Mechanical Engineering
¹²³⁴ Dr. Babasaheb Ambedkar College of Engineering and Research, Nagpur

Abstract— Air compressor, as the name indicates, is a machine to compress the air and to raise its pressure. The air compressor sucks air from the atmosphere, compresses it and then delivers the same under a high pressure to a place where the supply of compressed air is required. It is based on the energy stored in air under pressure and the heart of the system is the air compressor. To run air compressors, a lot of electrical energy is required depending upon the output pressure of the air. The non-renewable resources to produce electricity have become limited and are near extinction, leading to high energy cost or energy crisis. In such situations, renewable sources like solar power are very helpful and the application of this technology to run air compressor is known as solar air compressor.

Key words: maximum power point tracking (MPPT), Air compressor

I. INTRODUCTION

Seeing the today’s scenario there is a current global need for clean and renewable energy sources. The first problem is that the fossil fuels are depleting in a rapid rate and are harder to retrieve. The consequence is that we can be facing an energy crisis in the future if we are not careful today. The energy prices will skyrocket and not be available for many individuals or countries. To avoid this doom scenario we need to find alternatives and use them to their full potential. The second problem is that the fossil fuels that are widely used today are harmful for the environment. In the early seventies and eighties there were people and even scientist who preach otherwise, but today the negative effects are showing. The earth is warming up and climates are changing. There are parts in the world were there be more rain and sunshine and others parts will become dryer then they already are. Another negative effect is that the ozone layer is getting thinner which also leads to a warming up of the earth. These two effects complement each other and make it even more crucial to make another step in a different direction. This step will lead us to the use of renewable energy.

II. LITERATURE REVIEW

A. Design of Solar-Panel Energy System Fang Lin Luo:

Industrial Electronics and Applications (ICIEA), 2011 6th IEEE Conference on
DOI: 10.1109/ICIEA.2011.5975976
Publication Year: 2011, Page(s): 2304 - 2309

1) Abstract:

Sun offered sunlight and hit (with chemical effects) to earth continuously over millions years, and will offer millions years onwards. The tremendous energy offered from sun is thousands times higher than the total energy consumption used by the world in the present time. The solar panel is the equipment to convert transferring the sun sunlight and hit into electrical energy, it is a renewable energy resource. Unfortunately, the solar panel energy is uncertain and unstable. How to use the energy source is the engineering topic. This paper introduces a method to obtain a stable energy from solar panel energy system.

B. Air compressor:

Simulation of a solar powered air compressor
Kokaew, V.; Moshrefi - Torbati,M.; Sharkh, S. M.
Environment and Electrical Engineering (EEEIC), 2011 10th International Conference on
DOI: 10.1109/EEEIC.2011.5874681
Publication Year: 2011 (IEEE CONFERENCE PUBLICATIONS)

1) Abstract:

In this paper we discuss the simulation of a solar powered air compressor comprising a cylinder and a compressor coupled to a vector controlled induction motor which is fed from a photovoltaic array with maximum power point tracking (MPPT). The induction motor speed is controlled to maintain a constant pressure in the cylinder. In the model, the effect of temperature difference between the inside and outside of the cylinder on compressor efficiency is taken into account. The model is used to investigate the operation of the system and provide an insight into the effect of temperature, load and output flow rate on system efficiency. The model will help with design of the control system.

III. WORKING PRINCIPLE

![Fig. 1: Line Diagram of Working Model](image)

This system basically uses solar energy which is converted into electricity by the panels through which battery is charged. The battery gives current to the DC air compressor. The compressor then discharges the air at high pressure to the storage tank. The air which is stored at high pressure is then used by different applications like spray guns, cleaning, and power backup.
A Solar based Working Model to Run Air Compressor

All rights reserved by www.ijsrd.com 2160

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Equipment</th>
<th>Specifications</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Solar panel</td>
<td>10 W</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Battery</td>
<td>12 V, 7.5 Ah</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>Compressor</td>
<td>150 psi/10 bar</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>Storage tank</td>
<td>35 lit. M.S.</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Spray gun</td>
<td>6 bar</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1: List of Components

A. Selection of Compressor:
- Maximum pressure required for above operations including losses is 5 bar.
- Time required to fill the storage tank should be minimum.

To fulfill the above condition, compressor should develop more than 5 bar pressure, thus compressor of capacity 10 bar shall fulfill the requirements and is readily available in market according to the survey.

B. Storage Tank (Requirement by Calculations):
- The various capacity of storage tanks are available in market are: 22 lit, 35 lit, 100 lit, 200 lit (market survey).

C. Time Required To Fill the Storage Tank:
Capacity of storage tank = 35 L
Displacement of compressor = 2 cm³
Total discharge of compressor = 2 cm³*2000 rpm = 4*10⁻³ m³/minute = 4 L/minute

To find the time required to fill the storage tank, equating capacity of storage tank and total discharge of compressor,
35 L = 4 L/minute
Therefore, time required = 34/4 minutes = 8.75 minutes

Considering, the forward and the return stroke of reciprocating compressor, the total time required will be twice.
Therefore the total time = 18 minutes

D. Calculation For Power Required To Run The Compressor:
Different batteries available in market.
12 V, 3.5 Ah
Power = 12 * 3.5 = 42 Watt
12 V, 7.5 Ah
Power = 12 & 7.5 = 90 Watt

Power required to run the compressor is 168 Watt (12 V * 14A)
Therefore we select battery of power outage 90 Watt.
When the battery is completely charged, the compressor would run for about 30 minutes, till the battery is completely discharged.

E. Selection of Solar Panel:
To charge the battery of 12 V, 7.5 Ah we have to select the solar panel of voltage rating greater than 12 V.

Based on the market survey carried out solar panel of specifications 10 Watt, 13.5 V is best suited.

Time required to charge the battery:
Battery : 12 V, 7.5 Ah
Power of solar panel = Voltage (V)* Current(I)
10 watt = 13.5 * I
I = 0.75 Ampere
Therefore, time required to charge the battery = 7.5 Ah / 0.75 A =10 hours.

V. ADVANTAGES
1) Sunlight is everywhere and the resource is practically inexhaustible. Even during cloudy days we still receive some sunlight and it is this that can be used as a renewable resource.
2) Solar energy is an excellent alternative for fossil fuels like coal and petroleum because solar energy is practically emission free while generating electricity.
3) Solar power can generate electricity no matter how remote the area as long as the sun shines there.
VI. FUTURE SCOPE

1) In Agriculture: Our project model can help the farmers to get rid of this problem. Since our project model is small in size and portable, therefore it will prove to be a boon for them.

2) In Automobile Service Station: A bigger version of the prototype that we have developed would prove to be a boon for roadside bicycle stores and automobile service stations and also can be made useful for the service centre.

VII. CONCLUSION

The problem of shortage of available fossil fuels and eco-friendly air compressor system gave rise to the solar powered air compressor system.

For the further work of the project, it was necessary to study conventional air compressor system to find its suitable alternative. After studying that and analysing different options, solar powered air compressor proved to be the best.

VIII. ACKNOWLEDGMENT

Keeping in view the increasing importance of renewable energy, this project work has been done. We are indebted to many persons for their help and contributions during the preparation of this prototype. We are very thankful to our guide Prof. G.M.Dhote for his help in providing reviews, ideas and suggestions that improved our project work. Because of inspiring and guidance provided by him, the project work is reached up to success level. We also acknowledged with gratitude Dr. S.V.Prayagi HOD Mechanical Engineering Department, DBACER, Nagpur, for his constant support and encouragement throughout the course work. We are obliged to Dr. V. H. Tatwawadi Principal, DBACER, Nagpur, for his constant support in overcoming various different issues we faced during the course work. We would like to thanks our all professor for their guidance from time to time and inspiration at different stages of our B.E. Studies. We are grateful to the institution D.B.A.C.E.R. and R.T.M. Nagpur University for granting permission to us to undertake this project.

REFERENCES