

DEVELOPMENT OF A SOLAR POWER PLANT

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Project Statement

The project is the alternative design, where wind power is very low, of an effective solar power plant to generate sufficient wind flow and that can turn a turbine to generate power.

The project will be concentrating on three aspects:

Design of solar power plant

- Chimney
- Extension
- Turbine
- Inlet aperture
- Steel plate

Simulation - ANSYS Fluent programme

- Winters day in Pretoria
- Average day in Pretoria
- Summers day in Pretoria

Pilot solar power plant

- Manufacturing of power plant
- Capture of data

Simulation

ANSYS Fluent programme

Look into three different cases

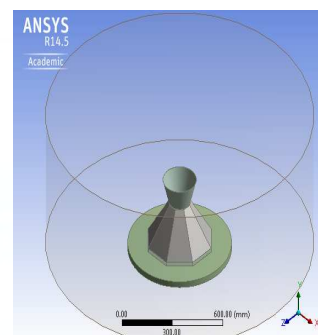
- Winter day in Pretoria
- Static Pressure
- Air Density
- Velocity in y direction
- Static Temperature
- Total Energy

Average day in Pretoria

- Static Pressure
- Air Density
- Velocity in y direction
- Static Temperature
- Total Energy

Summer day in Pretoria

- Static Pressure
- Air Density
- Velocity in y direction
- Static Temperature
- Total Energy



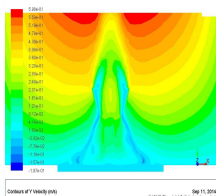
Design

The design is based on the shape of the cool towers of Eskom. The parts are as follow: Steel Plate (Base Plate), Inlet aperture, Chimney, Turbine and Extension.

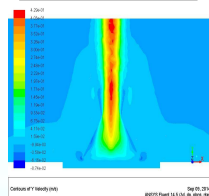
Material: Mild Steel with matt black finished

Turbine: Place top of chimney

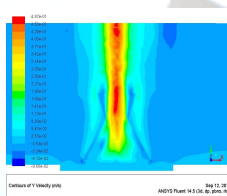
Winters day in Pretoria



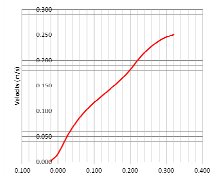
Average day in Pretoria



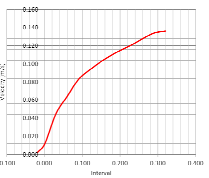
Summers day in Pretoria



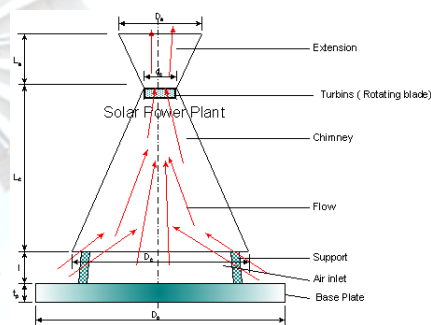
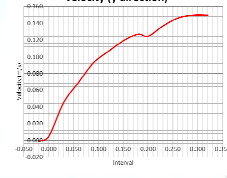
Velocity (y direction)



Velocity (y direction)



Velocity (y direction)



The Energy Equation

$$\frac{\partial}{\partial t}(\rho h) + \bar{V}(\bar{u}\rho h) = \bar{V}(k\bar{\nabla}T) + S_h$$

The Flow Rate Equation

$$Q = C A \sqrt{2 g h \frac{T_i - T_o}{T_i}}$$

Pilot solar power plant

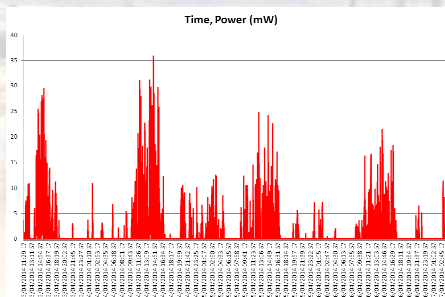
The pilot plant was manufacture from square tubing and mid steel plates. It was painted with matt black because to observe the most energy from the sun.

An EL-WIN-USB EasyLog data logger was used to took results in different scenarios:

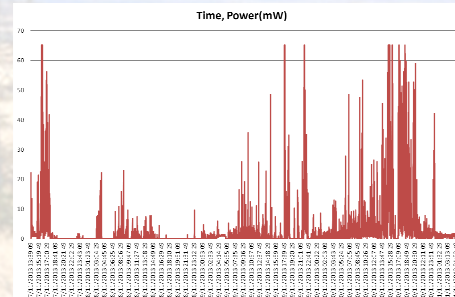
- Solar power plant without mirrors
- Solar power plant with mirrors



Solar power plant mirrors



Solar power plant without mirrors



Conclusion

Simulation

- Good flow rate according to the velocity
- Through out the power plant a changes in air density
- The maximum static pressure, top of chimney, by turbine

Pilot solar power plant

- For small solar pilot power plant get micro Watts and micro Voltages out
- The daily temperature playing a big roll
- It's clear that we generate maximum power between 10:00 am and 16:00 pm daily

Acknowledgements:

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