Refrigerator with a Sunpower Linear Compressor

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Background and Description:

This is the type of system in which refrigerant undergoes phase changes and is widely used in air conditioning. The refrigerator a linear compressor, a condenser, an expansion device, and an evaporator. The linear compressor, which can be a free- piston linear compressor, the condenser, the expansion valve and the evaporator are all in fluid communication. The evaporator is in thermal communication with the environmental space. Many chemical industries including oil refineries, petrochemical plants, natural and biogas processing plants use this kind of refrigeration mechanism on a large scale.

Major advantages of using linear compressors are

1. It is oil free. Cylinder wall and piston support mechanism allows contact free oscillation of the piston.
2. Both the amplitude and the oscillation of the piston can be controlled allowing the system to maintain high performance.

The refrigeration system stimulated here uses propane as a liquid refrigerant. Circulating refrigerant enters the adiabatic compressor in the thermodynamic state known as saturated vapor, the compressor increases it pressure and temperature and propane leaves the compressor in the super-heated vapor state. This super-heated vapor now enters the condenser which converts it to a saturated liquid at the same pressure. Now this saturated liquid is at a high pressure hence it is throttled with the help of a valve and a vapor-liquid mixture at atmospheric pressure is sent to an evaporator which converts the mixture to saturated vapor and the outlet stream from the evaporator is recycled and sent as the input to the adiabatic compressor.

Results:

Energy spent in various operations is as follows:

1. Heater energy (E1) = 1000kW
2. Compressor energy = 229.218kW
3. Condenser energy = 703.6kW
4. Evaporator energy = -525.617kW

Reference:

https://www.ohio.edu/mechanical/thermo/Intro/Chapt.1_6/refrigerator/refrig_problems.html