Introduction:

In the developing countries there is a growing interest in refrigeration for food and medicine preservation. Especially in rural areas, simple solar refrigerators working independently, i.e. not being provided with electrical energy, would be very valuable. Mechanical refrigerators powered by solar cells are available, but are too expensive.

The absorption cycle is a process by which refrigeration effect is produced through the use of two fluids and some quantity of heat input, rather than electrical input as in the more familiar vapor compression cycle. Both vapor compression and absorption refrigeration cycle accomplish the removal of heat through the evaporation of refrigerant at a low pressure and the rejection of heat through the condensation of the refrigerant at higher pressure. The method of creating the pressure difference and circulating the refrigerant is the primary difference between the two cycles. The vapor compression cycle employs a mechanical compressor to create the pressure differences necessary to circulate the refrigerant. In the absorption system, a secondary fluid or absorbent is used to circulate the refrigerant. Because the temperature requirements for the cycle fall into the Low – to – moderate temperature range, and there is significant potential for electrical energy savings.

Absorption would seem to be a good prospect for geothermal application. Absorption machines are commercially available today in two basic configurations. For applications above 320F (Primarily air conditioning), the cycle uses lithium bromide as the absorbent and water as the refrigerant. For applications below 320F, an ammonia/water cycle is employed with ammonia as the refrigerant and water as the absorbent.

We are using Electrolux refrigeration system for refrigeration process, refrigerator is also called “Three-fluids absorption system”. The three fluids used in this system are ammonia, hydrogen and water. - The “ammonia” is used as a refrigerant because it possesses most of the desirable properties. Though it is toxic, and not otherwise preferred in domestic appliances, it is very safe in this system due to absence of any moving parts in the system and therefore, there is the least chance of any leakage. - The “hydrogen” being the lightest gas, is used to increase the rate of evaporation (the lighter the gas, faster is the evaporation) of the liquid ammonia passing through the evaporator. The hydrogen is also non-corrosive and insoluble in water. This is used in the low-pressure side of the system. - The “water” is used as a solvent because it has the ability to absorb ammonia readily.
Objectives:

Nearly half of the vaccines in developing countries go waste every year due to temperature spoilage, according to the World Health Organization. Current transportation and storage methods in remote regions still rely on ice packs that last just a few days causing a large need for sustainable refrigeration where electricity is not readily available. We will be utilizing the adsorption intermittent refrigerator for simplicity as a focus for manufacturing, maintenance and daily use. It will consist of no moving parts and will be simple to reconstruct, and teach/learn how to operate. After the initial charge of each unit, the refrigerator is designed to work without any maintenance for three to five years, less it is ill-treated or improperly used.

The development of an inexpensive, modular, small scale device based upon the absorption refrigeration process. It is anticipated that to provide refrigeration using just solar energy.

Methodology:

1. Gathering the technical literature data regarding the project

Sources we referred:

- Modeling And Experimental Analysis Of Generator In Vapour Absorption Refrigeration System Christy V Vazhappilly*, TrijoTharayil**, A.P.Nagarajan
- Absorption Refrigeration Team Group for Environment and Energy Engineering, IIT KANPUR.
- Solar Ammonia Absorption Refrigerator Senior Design Project Jacob Buehn Adam Hudspeth Gary Villanueva Saint martin’s University Mechanical Engineering Department Faculty Advisor: Dr. Isaac Jung November 2011
- Design and construction of a solar driven ammonia absorption refrigeration system

2. Discussion about the feasibility of the project and material required

Components used:

- Evaporator box
- Condenser
- Generator
- 65w heater
- Accumulator
- Solar panel 120w
- Solar battery 40AH
- DC to AC convertor
- 20amps charge controller
3. **Selection of project parameters**

Upon market research and feasibility we are induced these parameters

- Design parameters were created to better define our Solar Refrigerator/Freezer
- Maximum component weight 20 Kg
- Maximum operating pressure 15 Bar and 3 bar at evaporator.
- Operational on solar energy, also works on electricity.
- Ambient cooling of components
- Developing cylindrical pressure vessel to pressurize ammonia instead of using pump.

Parameters where created to help differentiate the design from models that are currently in use today. Substantial cooling is an important parameter in maintain an operating system below 14 Bar, thus requiring a balance of energy used to charge the unit and the cooling capacity for condensing the refrigerant to a useful state.

4. **Fabrication of the component**

Since we are using ammonia as refrigerant even though we are using less concentrated, it’s very important to insulate the generator. We use the ozone friendly cyclopentane is activated as a motive agent for the PU insulation

We used sodium chromate for corrosion protection of the components.

5. **Testing the coefficient of performance of the system**

THEORITICAL COP

$$\text{COP}_{th} = \frac{T_5 (T_2-T_4)}{T_2 (T_4-T_5)}$$

COP= 0.8051

Where,

T1=Refrigerant temperature @ inlet of generator
T2= Refrigerant temperature @ generator
T3= Refrigerant temperature @ inlet of condenser
T4= Refrigerant temperature @ outlet of condenser
T5= Refrigerant temperature @ inlet of evaporator(after expansion)
T6= Refrigerant temperature @ outlet of evaporator
T7= Cooling Chamber temperature
Mw =mass of water collected in measuring jar
Refrigeration Effect:

\[ \text{RE} = \frac{Mw \times CPw \times (T_8 - T_7)}{\text{time}} \]

Duration of test = 5 minutes
Effective heating time = 180 seconds
\[ \text{RE} = \frac{(210 \times 10 - 6 \times 1000) \times 4.18 \times 10}{180} \]
\[ \text{RE} = 0.048 \text{ KW} \]

POWER INPUT=0.0912 KW

\[ \text{COP} = \frac{\text{Refrigeration Effect}}{\text{Power input}} \]
\[ = \frac{0.048}{0.0912} \]
\[ = 0.526 \]

Results And Conclusions:
Health and energy sector Present 40% electric power in the world is consumed by refrigeration and air conditioning systems. Our motto of the project is not to depend on electric power to carry out refrigeration process to preserve vaccines in rural areas.
Developing an affordable refrigerator that is capable of operating on solar energy. The will be capable of maintaining the optimal temperature range of 2 to 8° C for temperature sensitive medicines and vaccine. In our project we got the cop of .526 which is noticeable.

Scope For Future Work:
- Instead of using heater we can use direct heat from solar energy to carryout intermittent absorption process to make that we need strong guaranteed connections of components
- Use this technology for larger capacity volumes.
- Use of direct solar energy will eliminate the use of solar panel, charge controller, solar battery, DC to AC convertor etc by that overall cost will be reduced its half.