RESEARCH ARTICLE OPEN ACCESS

# Separation of Water to Concentrate Aloe Vera Juice:

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**ABSTRACT:**
Aloe Vera is a succulent plant and is found in different arid areas. Due to its healing effect and soothing properties it is being used in herbal medicines for years and its importance has grown due to use in cosmetic products. It contains more than thirty active ingredients, which are utilized in cosmetic and pharmaceutical industry. It also contains 98% water. To remove water from those active ingredient Reverse osmosis is used in order not to thermally damage the active ingredients present in the juice. A reverse osmosis is a separation technique which utilizes difference in pressure to segregate water from plant without damaging the active ingredients present in the plant. This research is dedicated to evaluate the parameter for separation of water from aloe Vera so that aloe Vera can be obtained in a form which can be utilized for different purposes such as cosmetics and medicine. Osmosis technique is preferred over other conventional technique for the separation purpose because it is not operated at high temperature, which will not damage the aloe Vera juice quality. Next step in this research is the preserving, drying and analysis of this juice so that this product can be utilized in versatile way.

## I. INTRODUCTION:

Aloe Vera is a juicy herb that was found from Africa and is found in arid areas of Pakistan as well. Due to its healing effect and soothing properties it is being used in herbal medicines for years and its importance has grown due to use in cosmetic products. It contains more than thirty active ingredients in it, which are utilized in cosmetic and pharmaceutical industry. It also contains 98% water. To remove water from those active ingredient Reverse osmosis is used in order not to thermally damage the active ingredients present in the juice. A reverse osmosis is a separation technique which utilizes difference in pressure to segregate water from plant without damaging the active ingredients present in the plant.

To minimize the storage and transportation expenditure, and to obtain farther storage, multi-stage vacuum evaporation is commonly employed for evaporation. This technique shows alteration in flavor of fresh, loss of color and a ‘‘cooked’’ flavor because of heat treatment. As customers normally like the flavor, smell, external look and taste of freshly obtained juices, researchers have put effort to introduce new methods of maintaining such properties of recently squashed juice in the concentrate and finally in the reconstituted juice. Many attempts have been put forward to introduce better process like freeze concentration, sublimation concentration and membrane concentration (ultrafiltration and reverse osmosis) processing of improved juice quality. Membrane concentration is the most viable substitute.

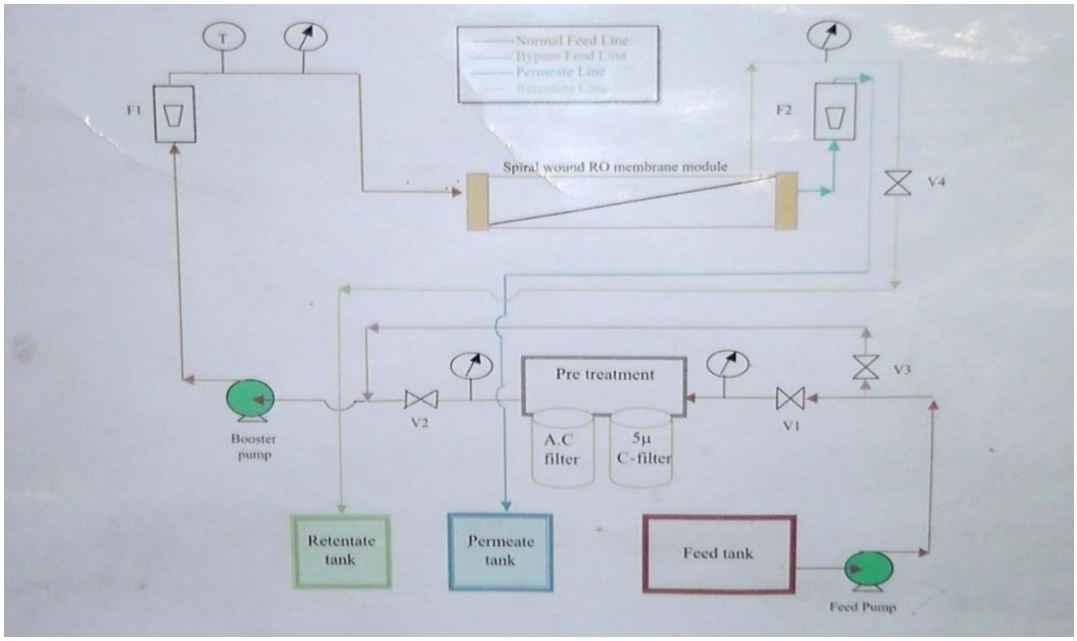
## II. Experimental:

### Material and Methods:

Following steps are involved in the preparation feed for experimentation, Removal of dust from aloe Vera leaves by washing it with water, carefully peeling off the leaves to get Aloe Gel, Separation of gel from latex by washing with water, Blending of Aloe Vera Gel to normalize the Gel. This process will ultimately lessen the viscosity of the liquid while at the same time preserving the chemical integrity of the ingredient, filtering the pulp from blend manually.

*Blended Aloe Vera gel is fed to the feed tank manually. Aloe Vera juice is fed through a double impeller centrifugal magnetic pump, which in turn is fed to booster pump, which raises the fluid to desired pressure and reaches the spiral wound reverse osmosis membrane module. The flow rate of the pre-treated aloe Vera juice is measured by Rota meter F1 before entering the membrane assembly. The

pressure and temperature gauges installed at the entrance of membrane assembly measures pressure and temperature of the feed.Filtration takes place in the membrane. It divides into two streams i.e. permeate or product stream and retentate or concentrate stream. Permeate is that stream which has low TDS as compared to feed and is allowed to pass through the pores of the membrane module. The flow rate of permeate is measured by Rota meter F2 and is collected in permeate or product tank. The retentate or concentrate is that stream which does not pass through the pores of membrane and is collected in retentate tank. The pressure drop of the RO membrane is measure by the pressure gauges at the entrance and exit of the membrane. Each component of the rig is discussed in detail in next section.




## III. RESULTS AND DISCUSSION:

**Feed Preparation:**

Weight of aloe Vera leaves = 40 kg
Weight of aloe Vera gel = 3.6 kg
Quantity of blended aloe Vera gel = 1.9 L
Specific gravity of blended aloe Vera gel = 1.1526
Feed Analysis
Total dissolved solid test
1 mg/L = 1ppm
As TDS in 1 L of feed = 1.2 g/L
= 1200mg/L

**Osmotic Pressure Calculation:**

1200 mg/L = 1200 ppm
Multiplying factor 0.01 psig/ppm
1200*0.01 = 12 psig

**Effect of feed Pressure on Permeate Concentration**

Feed Concentration = 200 ppm
Specific gravity = 1.1326
Temperature = 25 $^{O}$C
PH = 6.5

Table1:Pressure vs. Permeate Concentration

| Pressure (Psi) | Permeate Concentration (ppm) | % Rejection |
|---|---|---|
| 35 | 613 | 48 |
| 40 | 597 | 50 |
| 45 | 524 | 56 |
| 50 | 497 | 58 |
| 55 | 410 | 65 |
| 60 | 357 | 70 |

% Rejection = $((C_f - C_p)/ C_f) \times 100$
$C_f$ = Concentration of Feed (ppm)
$C_p$= Concentration of Permeate (ppm)

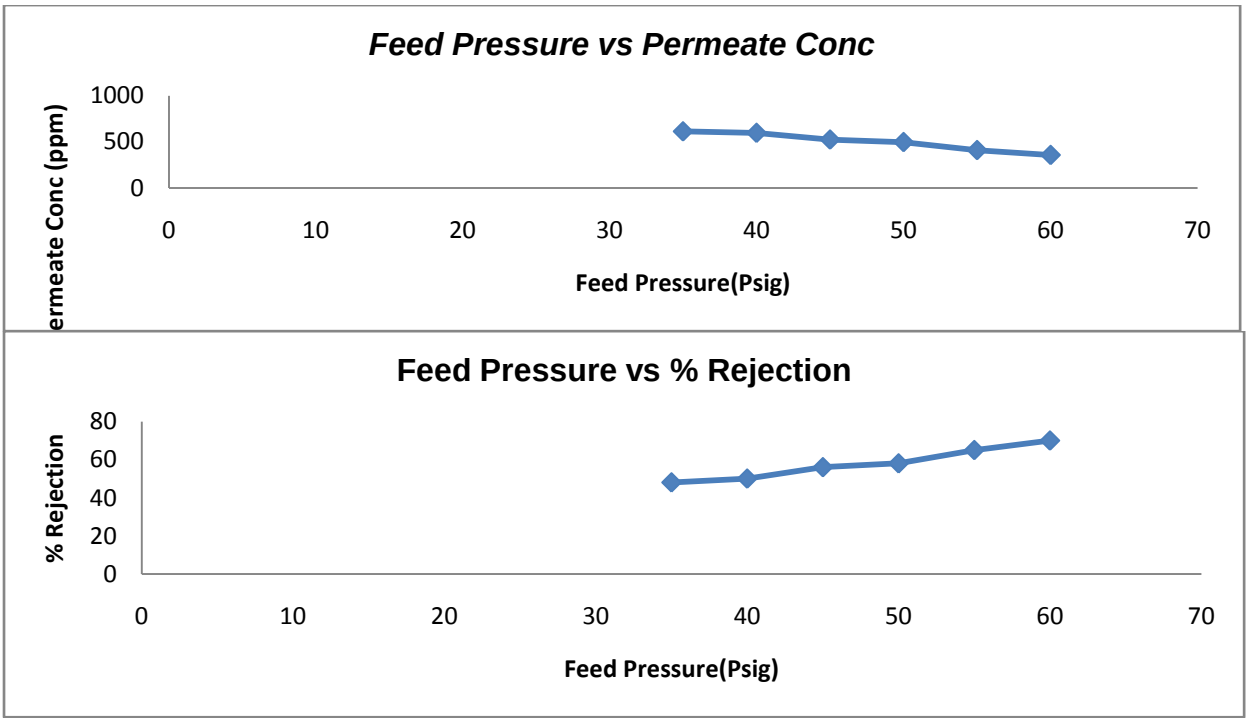
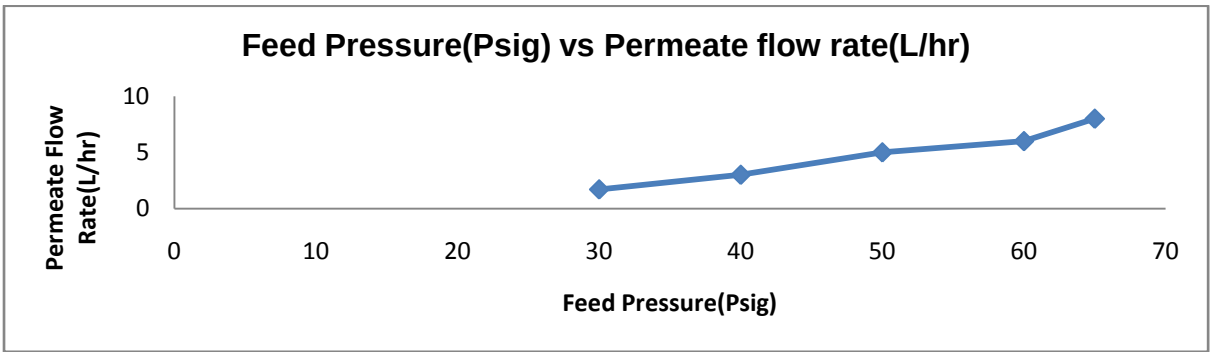



Table2:Effect of Feed Pressure on Permeate Flow rate &% age Permeate recovery

| Feed Pressure (Psig) | Feed Flow Rate (L/hr) | Permeate Flow Rate (L/hr) | % Permeate Recovery |
|---|---|---|---|
| 30 | 68 | 1.7 | 2.5 |
| 40 | 56 | 3 | 5.3 |

| | | | |
|---|---|---|---|
| 50 | 44 | 5 | 11.3 |
| 60 | 32 | 6 | 18.75 |
| 65 | 28 | 8 | 28.5 |



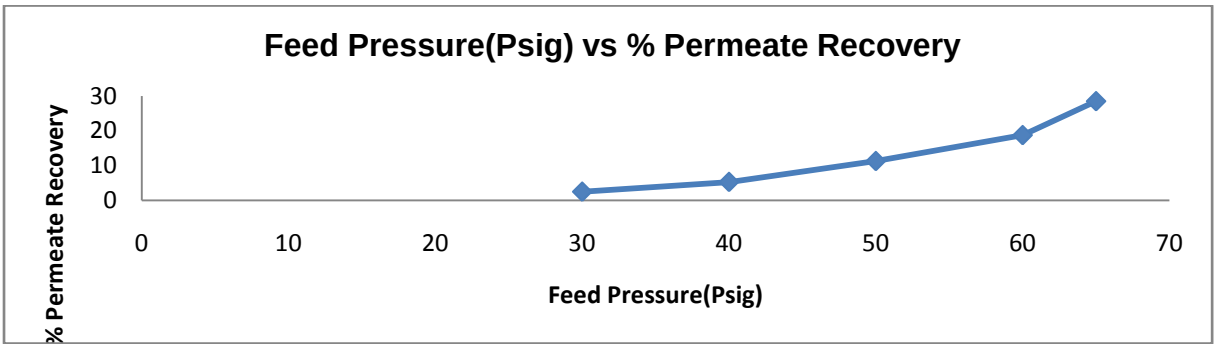




Table3:Effect of feed Temperature on Permeate Concentration
(Feed Temp @ $40^0$C)

| Pressure(Psi) | Permeate Concentration(ppm) | % Rejection |
|---|---|---|
| 35 | 580 | 51 |
| 40 | 460 | 61 |
| 45 | 390 | 67 |
| 50 | 330 | 72 |
| 55 | 290 | 75 |
| 60 | 255 | 78 |

Table4: Effect of feed Temperature on Permeate Concentration:
(Feed Temp @ 60 $^{o}$C)

| Pressure (Psi) | Permeate Concentration (ppm) | % Rejection |
|---|---|---|
| 35 | 440 | 63 |
| 40 | 380 | 68 |
| 45 | 330 | 72 |
| 50 | 290 | 75 |
| 55 | 250 | 79 |
| 60 | 210 | 83 |

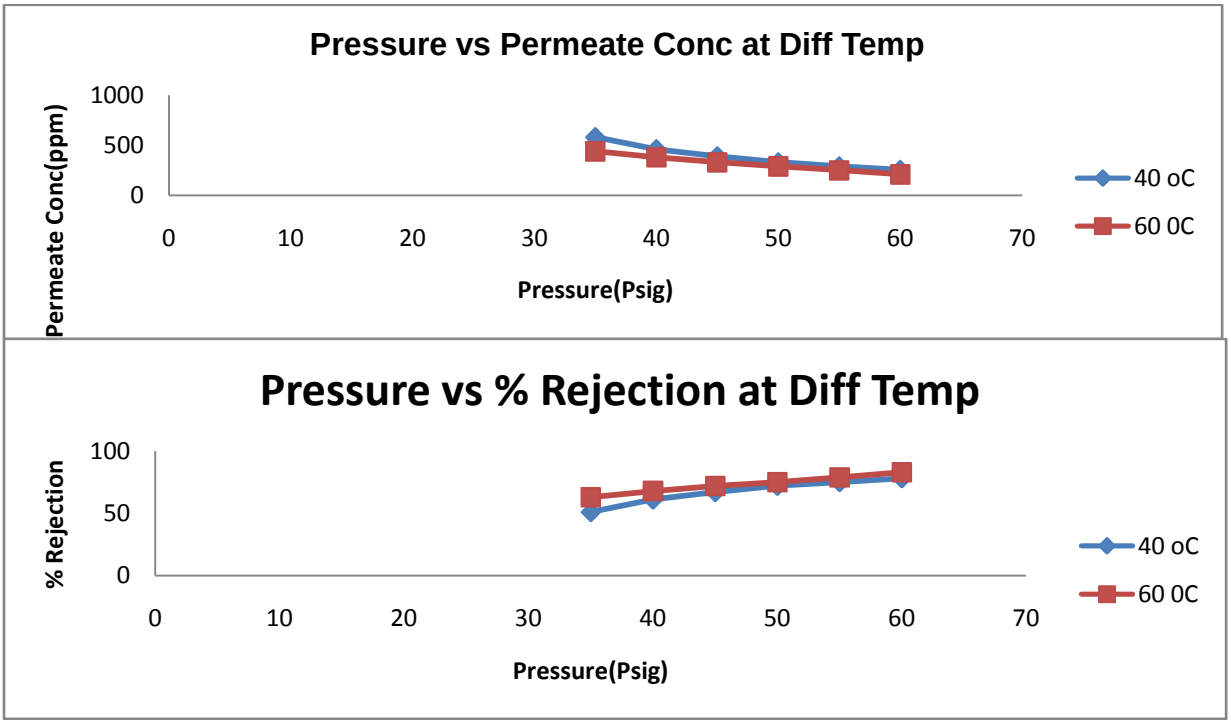


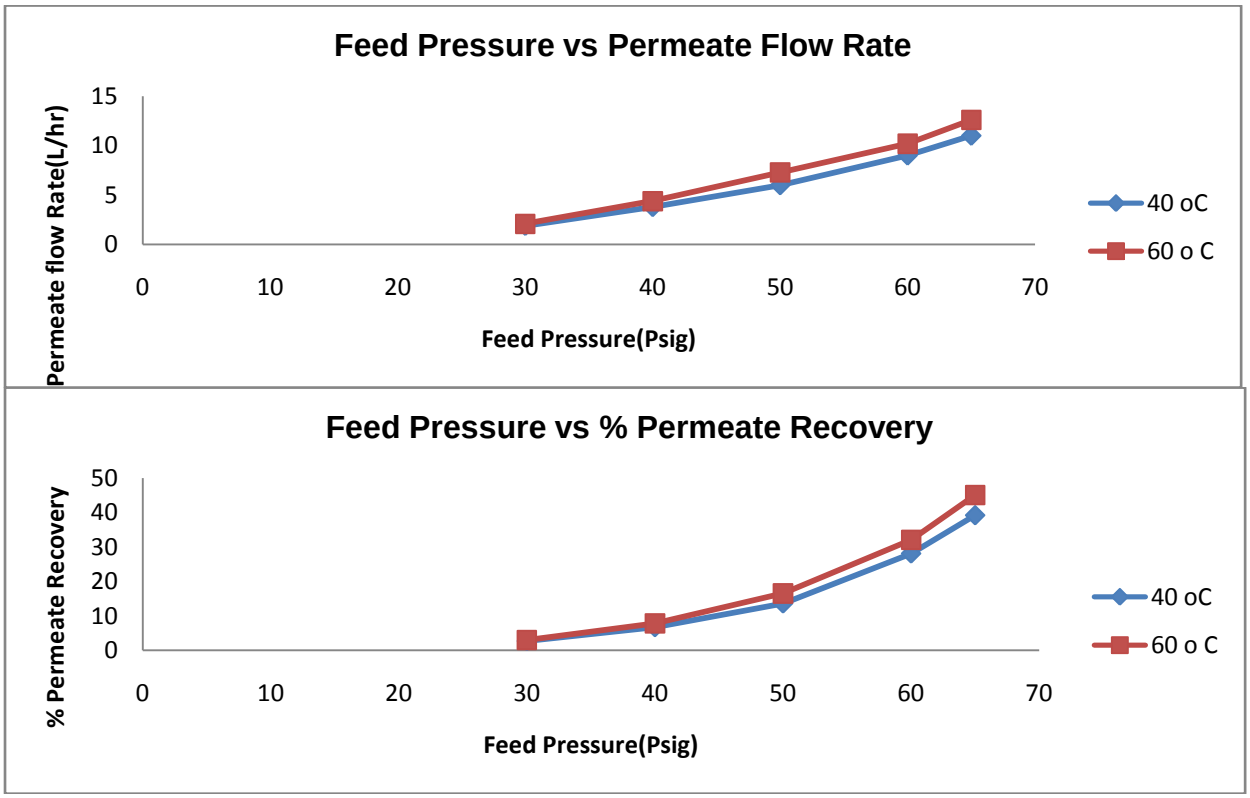

Table5: Effect of Feed Temperature on Permeate Flow rate &%age Permeate recovery
(Feed Temp at 40 $^{o}$C)

| Feed Pressure (Psig) | Feed Flow Rate (L/hr) | Permeate Flow Rate (L/hr) | % Permeate Recovery |
|---|---|---|---|
| 30 | 68 | 1.9 | 2.7 |
| 40 | 56 | 3.8 | 6.7 |

| | | | |
|---|---|---|---|
| 50 | 44 | 6 | 13.6 |
| 60 | 32 | 9 | 28.1 |
| 65 | 28 | 11 | 39.2 |

Table6: Effect of Feed Temperature on Permeate Flow rate &%age Permeate recovery
(Feed Temp at 60 $^{o}$C)

| Feed Pressure(Psig) | Feed Flow Rate(L/hr) | Permeate Flow Rate(L/hr) | % Permeate Recovery |
|---|---|---|---|
| 30 | 68 | 2.1 | 3.0 |
| 40 | 56 | 4.4 | 7.8 |
| 50 | 44 | 7.3 | 16.5 |
| 60 | 32 | 10.2 | 32 |
| 65 | 28 | 12.6 | 45 |



## IV. RESULTS AND DISCUSSION:

**Effect of Feed Pressure on permeates Concentration:**

As the feed pressure increases, the concentration of solid matter in the permeate decreases. The graph of above relation indicates that feed pressure and permeate concentration have inverse relation.

**Effect of Feed Pressure on % solid Rejection:**

As feed pressure is increased, the solid matter rejection is also increased this can also be inferred that permeate concentration and % solid Rejection have inverse relationship.

**Effect of Feed Pressure on permeates Flow Rate and % Permeate Recovery:**

As feed pressure is increased, both permeate flow rate and % permeate recovery increases. It shows that both permeate flow rate and % permeate recovery is directly proportional to the feed pressure.

**Effect of Feed Temp & Pressure on permeates Concentration:**

Relationship between feed temp & pressure and permeate concentration is same as discussed earlier but changing the temperature of feed changes the permeate concentration at the same pressure.

**Effect of Feed Temperature &Pressure on % solid Rejection:**

Relationship between feed Temp & pressure and % rejection is same as discussed earlier. Increase in temperature indicates that more solid is rejected at the same pressure for higher feed temperature.

**Effect of Feed Temp &Pressure on permeates Flow Rate &% Permeate Recovery:**

Increasing the temperature indicates that at the same feed pressure more is the flow rate of permeate and higher is the % permeate recovery

**Conclusion:**

The operation conditions at operating pressure range between 45-60 psig and feed temperature of 60 $^0$Chad given much better and improved results.

## Acknowledgements

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