ABSTRACT
In a membrane separation technique, pervaporation used to purify the chemicals. Pervaporation, in its simplest form, is an energy efficient combination of membrane permeation and evaporation. Nowadays to separate alcohol-water mixture by hybrid distillation pervaporation gaining significant attention in industry. Normally Conventionally azeotropic distillation is used to remove the water from an azeotropic isopropyl alcohol (IPA)/water mixture. The aim of this paper is to show the comparative study of pervaporation over a conventional azeotropic distillation for the separation of IPA/water mixture. By the use of new technique we can reduce operating costs and waste water treatment and eliminate the use of chemical entrainer. All this aspects lead to the development and adoption of new better technology over a conventional one.

1. Introduction
Pervaporation, is combination of membrane permeation and evaporation. It’s considered an attractive alternative to other separation methods for a variety of processes. Low temperatures and pressures involved in pervaporation, it often has cost and performance advantages for the separation of constant-boiling azeotropes, so it called energy efficient process. Additionally, pervaporation can be used for separation heat sensitive products, breaking azeotropes, dehydration of solvents and other volatile organics, organic/organic separations such as ethanol, IPA and methanol removal, and wastewater purification.

2. Pervaporation:
Pervaporation involves the separation of two or more components across a membrane by differing rates of diffusion through a thin polymer and an evaporative phase change comparable to a simple flash step.(1)

A concentrate and vapor pressure gradient is used to allow one component to preferentially permeate across the membrane. A vacuum applied to the permeate side is coupled with the immediate condensation of the permeated vapors. Pervaporation is typically suited to separating a minor component of a liquid mixture, thus high selectivity through the membrane is essential.

Liquid transport in pervaporation is described by various solution-diffusion models. The steps included are the sorption of the permeate at the interface of the solution feed and the membrane, diffusion across the membrane due to concentration gradients (rate determining steps), and finally desorption into a vapor phase at the permeate side of the membrane.

The first two steps are primarily responsible for the permeability. As material passes through the membrane a "swelling" effect makes the membrane more permeable, but less selective, until a point of unacceptable selectivity is reached and the membrane must be regenerated.

The other driving force for separation is the difference in partial pressures across the membrane. By reducing the pressure on the permeate side of the membrane, a driving force is created.

Another method of inducing a partial pressure gradient is to sweep an inert gas over the permeate side of the membrane. These methods are described as vacuum and sweep gas pervaporation respectively. (1)

3. Application of Pervaporation:
- Dehydration of organic solvents (e.g., alcohols, ethers, esters, acids)
- Removal of dilute organic compounds from aqueous streams (e.g., removal of volatile organic compounds, recovery of aroma, and biofuels from fermentation broth)
- Organic–organic mixtures separation (e.g., methyl tert-butyl ether (MTBE)/methanol, dimethyl carbonate (DMC)/methanol). (2)

4. Mass Transfer Process Along Membrane in Pervaporation
The pervaporation of dilute organic-water mixtures has been relatively well described by a resistance-in-series model. The mass transfer process of a single component across the membrane occurs in 4 consecutive steps:
The purification of IPA traditionally occurs through azeotropic distillation. Fig. 4 gives an overview of an azeotropic distillation process for the dehydration of IPA, using benzene as an entrainer. In a first column, the aim is to obtain a top product with a composition close to the azeotropic composition (we will consider distillation up to 83.0wt.% IPA and 17.0wt.% water). The top product of this distillation column is further dehydrated by a pervaporation unit. The top product can be dehydrated up to the final desired water concentration by pervaporation (Fig. 5) or it can be dehydrated partially by pervaporation to break the azeotrope (we will consider distillation up to approximately 5wt.% water) and then sent to a second distillation column in which it is dehydrated up to the final desired IPA concentration (Fig. 5). Different types of membrane like polymeric and ceramic membrane can be used for hybrid systems. (4)

**5. Dehydration of IPA by Azeotropic Distillation**

A mixture containing 50wt.% IPA and 50wt.% water is used to separate the IPA from water and to reach up to a final IPA concentration of 99.5wt.%. The temperature of the initial feed mixture is 20°C.

**6. Dehydration of IPA by Hybrid Distillation Pervaporation Process**

A very interesting alternative might be a hybrid process combining distillation with pervaporation. First the feed mixture is sent to a distillation column to obtain a top product that has a composition close to the azeotrope (we will consider distillation up to 83.0wt.% IPA and 17.0wt.% water). The top product of this distillation column is further dehydrated by a pervaporation unit. The top product can be dehydrated up to the final desired water concentration by pervaporation (Fig. 5) or it can be dehydrated partially by pervaporation to break the azeotrope (we will consider distillation up to approximately 5wt.% water) and then sent to a second distillation column in which it is dehydrated up to the final desired IPA concentration (Fig. 5). Different types of membrane like polymeric and ceramic membrane can be used for hybrid systems. (4)

**7. Conclusion**

Comparative study of dehydration of IPA for different shows that hybrid distillation of pervaporation method is better because of certain advantages. In hybrid distillation pervaporation system very low energy required compared to conventional system. Use of carcinogenic chemical like benzene as entrainer can be eliminated. Many economical study shows that capital cost and operating cost can be reduced compared to conventional methods.