

Chapter 5

CONCLUSION

Concentration of NR latex by UF could become a viable option to solve environment related problems inherent with the current mode of concentration using centrifugation. Through the correct choice of membrane material and operating conditions, it is possible to obtain a clear serum as permeate.

Useful bio-chemicals such as quebrachitol, which is a chemical feedstock for the synthesis of a range of bioactive material, is present in the serum. In this manner replacement of centrifugation with UF for concentration of NR latex could pave the way to zero discharge and cleaner production.

For a successful concentration of NR field latex the tubular ultrafiltration module was suitable, since latex has a high solid content. As latex particles are negatively charged and highly alkaline in nature with pH of 10-11, hydrophilic membrane material would have been a better choice. With a limited choice of commercial membrane at hand, 100kD PVDF type of membrane was found to be a suitable alternative, although it is rather hydrophobic in nature but can be utilized at a wide pH range of 1.5 – 11.

The NR latex composite preservation system PS1 [1.0 % of ammonia, 0.1% ammonium laurate (from 10 % Solution) and 0.025%TMTD/ Zinc Oxide (from 50% dispersion with a ratio of1:1)] was found to be a better alternative. The high pH

caused by the ammonia in the feed (10.5 – 11.00) prevented the microbial action and kept the latex stable for UF runs.

The feed tank should be kept closed so that the ammonia does not get released to the factory surroundings.

The feed pump should be dismantled after every 20 hours of UF run so as to remove any coagulated rubber attached to the diaphragm and other cavities and clean the entire pump.

In Experiment UF4 to determine maximum concentration attainable, the optimum TMP was set at 2.75 barg. This TMP was relatively low below the maximum value of 3 barg and critical flux of $6 \times 10^{-6} \text{ m}^3/\text{s.m}^2$ (Figure 4.13). This was done to prevent any membrane compaction and also to be working at the pressure dependent region which is below the TMP value of 3 barg. Operating UF process at a permeate flux lower than or equal to critical flux could reduce or eliminate irreversible membrane fouling [34, 38]. Polarization and gel layer formation would be minimal. The cross flow rate of the feed was 300ml/s so as to create a turbulent flow where the Reynolds number was calculated to be above 4000. This could impart more shearing action against the membrane and prolong gel layer formation thus helping to maintain a constant permeate flux and subsequently help to hasten the process of concentration.

During the 20 hours of UF run the concentration NR field latex was increased from its initial DRC of 29% to a final DRC of 46.09% (Table 4.6). Taking the area of membrane to be 0.024 m^2 the increase in DRC value per square meter of membrane area per hour (m^2/hr) was 29.16%.

It is found that a temperature of 16 °C occurred during the concentration process. The larger the membrane area in a system, the greater the permeate rate, everything else being equal [42].

An increase in the membrane area could increase the level of concentration within a shorter period of time while taking precaution to control the rise in temperature with a suitable cooling system [42, 43]

The membrane cleaning procedure which included 3 cycles of DI water rinsing followed by circulation of 0.2% of NaOH for 30 minutes could at least restore the flux to 80% of the value for a new membrane. More effective cleaning procedure is needed to be developed during the future work to be carried out, so as to get a better flux recovery after membrane cleaning. The membrane left overnight should be packed with DI water instead of cleaning solution so as to prevent membrane matrix bleed or rupture.

The membrane cleaning procedure was able to produce flux recoveries of 81.73% (Mem-01-01), 92.68% (Mem-03-01) and 86% (Mem-04-01) respectively. From the results of the flux recovery the cleaning procedure was satisfactory although the procedure could not completely eradicate the permanent fouling of the membrane.