



Panoramic view of Piacenza, Italy.
Home to ARP Tomato Juice Concentration Site.

Case studies and References B SERIES



TOMATO JUICE CONCENTRATION

CASE STUDY - CONCENTRATION OF TOMATO JUICE B1 SERIES MODULES AND AFC99 MEMBRANES

Case Study: ARP, near Piacenza, Italy

Background

ARP has expanded continuously since 1958 when 7000 tonnes of tomatoes were processed, up to 100,000 tonnes/year (1984 figures). The factory produces 28°-30° Brix and 36°-38° Brix concentrate for major European clients.

Previous Process

In the 1983 season the factory process was the standard hot break process with feed juice at an average of 4.5° Brix going to 2 large triple effect evaporators which concentrate 80 tonnes/hr of feed juice directly to concentrate/paste product. The water removal requirement for 28°-30° Brix product was about 67 tonnes/hr, with a steam consumption of about 25 tonnes/hr at an operating cost of £500/hr.

New Process

ARP decided to expand production by approximately 50% over a two year period. Two competitive offers for a third large triple effect evaporator were considered in conjunction with PCI's reverse osmosis system.

The traditional evaporator scheme would have required additional capital investment in steam boiler capacity, evaporator cooling system and the related civil engineering costs for these three major items. In addition to this, further increases in the already high fuel oil costs would make the evaporation step a major factor in the overall total processing costs for the factory.



1st Season

The first stage of the expansion was carried out by installing the 42 tonnes/hr three stage PCI reverse osmosis plant, the line pre-concentrated to 8.5° Brix, removing almost 20 tonnes of water per hour, with a total energy consumption of approximately 150kw of electrical power.

The existing evaporators carried out the final concentration to 28°-30° Brix or 36°-38° Brix, the initial expansion with the first reverse osmosis line increased overall plant capacity by 900 tonnes/day.

2nd Season

two additional lines were ordered for 1985 to give a total reverse osmosis plant capacity of 126 tonnes/hr. All tomato pulp juice is pre-concentrated to 8.5° Brix prior to the existing evaporators and the overall capacity of the factory was increased by nearly 50%. The overall factory scheme is shown below:



| Operating Costs (1995 figures) | |
|--------------------------------|----------------------------------------------------------------------------|
| Existing | £3.30/tonne water removed (based on steam cost plus electricity) |
| PCI | £1.70/tonne water removed (based on steam cost plus electricity) |
| Saving | Removing 59.3 tonnes/hr of water by RO for 21 hr/day - £1,922 a day |

CONCLUSION

- Increase processing capacity by up to 50%
- Reduce operating costs by £1,992/day (1995 figures)
- Avoid costly investments in a new evaporator plus the associated new steam, boiler, cooling water system and services

The Situation Today

ARP's production has expanded to 150,000 tonnes of process tomatoes a year. New products have been added to their range such as cubed chopped tomatoes and concentrated tomato juice known as 'Passata'.

The number of active farmers around Piacenza forming part of the co-operative has reduced slightly. However, they have embraced the new technologies allowing them to produce higher quality products with cost-effective production methods.

LIGNOSULPHONATE FRACTIONS

CASE STUDY - RECOVERY OF LIGNOSULPHONATE
FRACTIONS
B1 SERIES MODULES AND PU120 MEMBRANES

Details on request

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PCI MEMBRANES

EFFLUENT TREATMENT PLANT

CASE STUDY - THE WORLD'S LARGEST TUBULAR MEMBRANE EFFLUENT TREATMENT PLANT (B1 SERIES MODULES AND ES404 (SOFTWOOD) & ES625 (HARDWOOD) MEMBRANES)

Case Study: Stora Nymölla AB, Sweden

Introduction

Stora Nymölla AB is one of the world's largest manufacturers of bleached magnifite pulp. Production of pulp started in 1962 at Nymölla, and actual paper manufacture began in 1972. At present, the mill's capacity is 300,000 tonnes per year, of which 200,000 tonnes is used by Stora Nymölla for the manufacture of high quality printing paper. The remaining pulp is sold to other paper mills. Two types of pulp are produced, Nymölla Red, which is a short fibre pulp made from beech and birch, and Nymölla Green, a long fibre pulp made from pine and spruce.

From the oxygen bleach stage of the pulping process, 300 tonnes per hour of effluent is produced (made up of 135 tonnes per hour from hardwoods and 165 tonnes per hour from softwoods). The average COD of this effluent is approximately 10gm/litre, therefore a total of about 3 tonnes of COD is produced every hour. Due to stricter legislation, and the need to be "green", it became necessary for Stora Nymölla to obtain the "Swan" mark for their products.

This is an independently awarded symbol indicating commitment to protecting the environment. The mill was already chlorine-free, but they needed to reduce COD emissions to achieve the "Swan" mark. The target was a 50% reduction in the total mass of COD discharged from the oxygen bleach stage. The retained 50% of the COD was to be contained in 2% of the original liquid volume so that it could be incinerated.



| Production Plant | |
|------------------|----------------------------------------------------------------------------------------------------------|
| System | 13 recirculation stages (7 for softwood and 6 for hardwood). |
| Process | 300m ³ /hr of effluent and producing 6m ³ /hr of concentrate |
| Modules | 1784 BT Modules in total Softwood stage contains 1084 modules Hardwood stage contains 720 modules. |
| Filtration Area | 4650m ² |

Trials

Stora Nymölla approached MoDo Chemetics who came to PCI Membranes, where we were invited to carry out trials. These were started in May 1993 using a multi-stage recycle pilot plant. The initial results indicated that Nymölla's bleach effluent was treatable with membranes, but that further work was required.

In October 1993, PCI returned to site with an ultrafiltration (UF) pilot plant. This was a two-stage plant fitted with three modules per stage, giving a total of 15.6m² membrane area. The plant could be operated in batch or continuous mode and at a stable concentration or VCF (volumetric concentration factor) within each stage.

The trials in May indicated the need for a 4000 Dalton cut-off membrane, and so PCI's ES404 polyethersulphone membrane was fitted in the pilot plant. The two streams of effluent (hardwood and softwood) needed to be treated separately in order that the retentate stream could be reused.

One target was to design a plant that could operate at low cross-flow velocities in order to keep energy consumption down. This proved to be possible for the softwood stream, and a total of about three months of continuous trials, operating 24 hours per day, were carried out on the softwood effluent using ES404 membranes.

During this time a number of different cleaning regimes were tested, and it was determined that a variable cleaning frequency was needed. Earlier stages were found to require more frequent cleaning, approximately once daily, and later stages could be run continuously for four days or more.

During the early part of the trials, hardwood effluent was also trialled using ES404 membranes. However, this stream proved to be far more fouling than the softwood effluent for these membranes even when a high crossflow was employed. Therefore a smaller pilot plant was then taken to site, and various other membranes were trialled for the hardwood using this plant, whilst the main pilot plant continued to produce data on the softwood effluent. It became clear that none of PCI's existing membranes was suitable and so a new membrane had to be developed. This was achieved in less than two months, so trials with the two-stage UF pilot plant were able to continue uninterrupted.

The new membranes worked exactly as anticipated, it was also discovered that all hardwood stages of the projected full-scale plant should be able to be operated for two days between cleans.

Production Plant

Once MoDo Chemetics had secured the order from Nymölla, the production plant was designed and built jointly by MoDo Chemetics and PCI Membrane Systems. Installation and commissioning was also carried out jointly, with engineers from PCI spending time working together with MoDo engineers in Sweden.

The final design was for two lines with a total of thirteen recirculation stages (7 for softwood and 6 for hardwood). Each softwood stage contains 152 modules and each hardwood stage 120 modules. The lines are designed such that they never have to stop. Any stage can be taken off line to enable it to be cleaned without interrupting the effluent processing.



View of feed end of softwood stages.
Note: Small diameter pipework – a feature of operating at low cross-flow rates.

Conclusion

Since January, 1995, the plant has met the required specification for both COD reduction and capacity, processing more than 300m³/hr of effluent and producing 6m³/hr of concentrate. Membrane life has been longer than forecast, with both power and cleaning chemical consumption also within the guaranteed limits.

In all PCI:

- Carried out close to 1000 hours of trial work
- Developed a new membrane in only two months
- Tailored two different cleaning regimes to the two feed types
- Designed a plant that successfully processes 300m³/hr of bleach effluent.

The plant has enabled Stora Nymöla to achieve the sought-after "Swan" mark.



View of feed end of sixth stage of hardwood line.
Note: Larger diameter feed pipework



13 stages of PCI 3.6 m long B1 modules. A total membrane area of 4650m².
Note: Stages are staggered to make space for re-membraning.