

VACUUM DRYING PLANT FOR EVAPORATOR CONCENTRATES

E.Benavides, ENSA

C/ Orense2, 3rd floor - 28020 MADRID (Spain)

Phone: (34) 915 553 617; Fax: (34) 915 563 149; e-mail: benavides.enrique@ensa.es

ABSTRACT

Volume reduction systems applied to evaporator concentrates in PWR and BWR save a significant amount of drums. The concentration to dry product is a technique that reaches the maximum volume reduction, compared to conventional techniques (cementation, polymerisation).

Four Spanish N.P.P. (3 PWR and 1 BWR) have selected ENSA's process by means of fixed "in drum vacuum drying system".

A 130-litre steel drum is used for drying without any additional requirement except vacuum resistance. This steel drum is introduced into a standard 200-litre drum. Five centimetres concrete shielding cylinder exists between both drums.

Final package is classified as **19 GO** according to ENRESA's acceptance code (dry waste with 5 cm concrete between 130-l and 200-l drum).

The generation of cemented waste in five N.P.P. versus dried waste will be reduced 83%. This reduction will save a considerable amount in disposal costs.

INTRODUCTION

The vacuum drying process for evaporator concentrates is a technique that improves the volume reduction factor when applied to borate waste and sulphate waste. When concentrate liquid waste are immobilised in a cement matrix only 140-150 litres of those waste may be introduced in a 200-l standard drum. If these concentrates are dried the number of drums are reduced dramatically. The comparison between cemented and dried drums is shown in Figure 1.

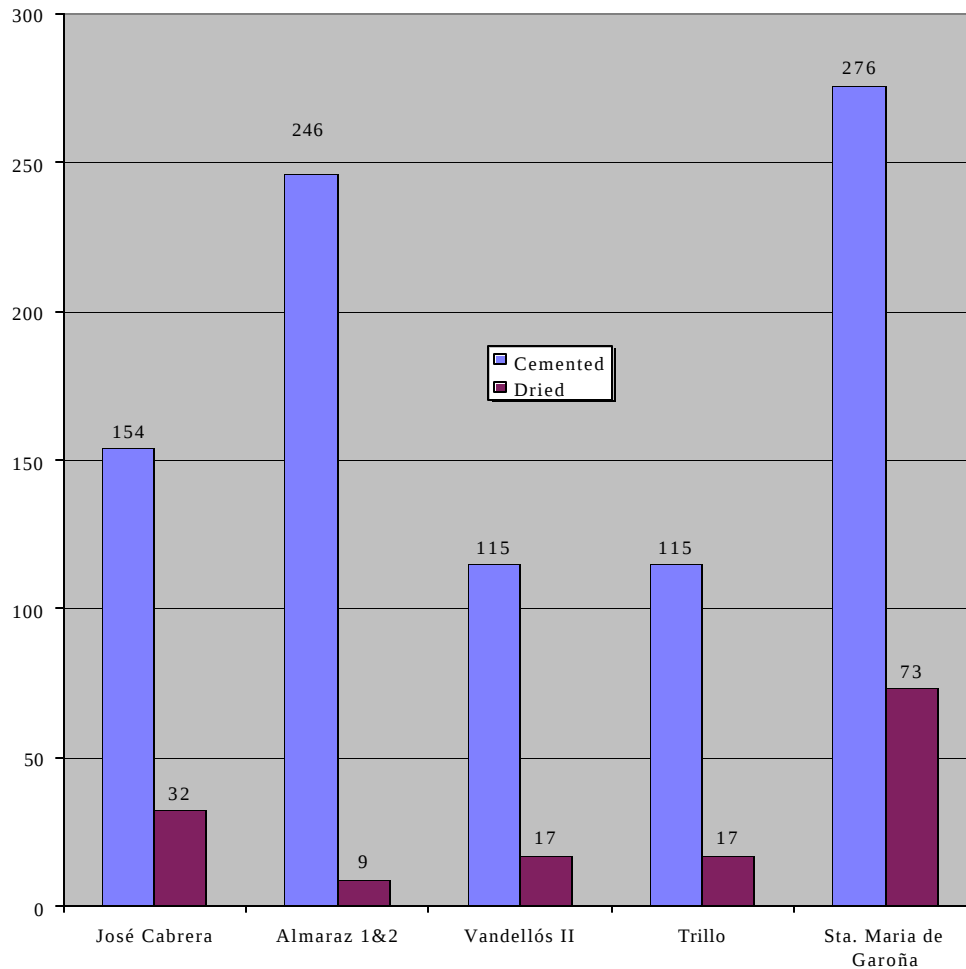


Fig. 1. Comparison between drums using cementation and drying technique in five Spanish NPP

DESIGN BASIS

The vacuum drying plant has been designed to treat the volume of the annual generation of evaporator concentrates in a concept of a fix installation, but modular. The average production of such waste for a nuclear plant of 1000 Mwe, is in the range of 15-20 m³ per year, and depends on the maximum concentration that the evaporation system installed could manage. According to the drum evaporation area, an evaporation rate of 6 l/hour will process 1m³/week (continuous basis 168 hours/week).

The recommendation is to set out at least two drying circuits. In two months operation all concentrates will be treated as well as for equipment availability.

GENERAL ARRANGEMENT

The drying plant has a modular concept, according to the customer needs, they may decide how many drying circuits will be required. Generally radwaste plant operation procedures prevail over

others. Two drying circuits will have enough capacity for treating the waste produced by a 1000 MWe plant.

The arrangement for two circuits drying system will require about 50 m². Concentrates feed tank should be installed separately in a shielded room, as well as the cooling equipment installed outdoors.

PLANT DESCRIPTION

The drying plant is made up of six sections:

- Concentrates tank
- Drying chamber
- Capping station
- Vacuum and condenser
- Cooling equipment
- Control panel

There is another section not directly involved in the drying process itself but completes the process to produce an acceptable package, that is the injecting cement machine and vibrating table.

Concentrates tank

This tank receives the waste from NPP waste storage tanks or from the evaporator discharge tanks. The aim of this tank is to be a buffer tank for homogenisation of the incoming waste and transfer to any of the drums to be dried.

Agitation, recirculation, heat tracing for crystallisation avoidance and complete level instrumentation is provided in the tank.

Drying chambers

Presently two drying chambers working in a parallel process are provided as standard supply. A parallelepipedic steel recipient forms each drying chamber. They are provided with an entrance door, electric heating and isolation and shielding.

A drum trolley introduces a 130-l empty and uncapped drum inside the drying chamber. The same trolley elevates the drum in order to connect the upper part of the drum to a head. The head is provided with all required connection to perform and

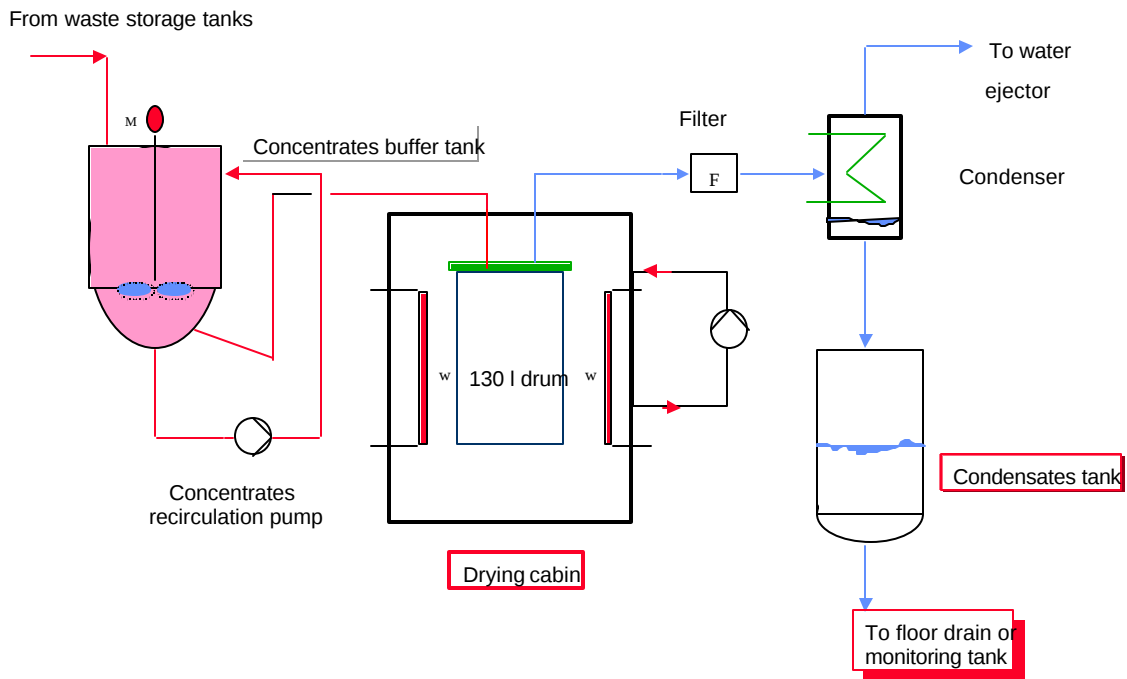


Fig.2 Schematic principle for in drum drying

control the process, (vg. waste inlet, vapours outlet, vacuum measurement), and level instrumentation. In Fig. 2 is shown the drying principle.

After several tests to assure the system tightness, the waste transfer from concentrates tank to the drum under process done by vacuum.

Capping station

The dried drum is capped automatically once the drum abandons the cabin; there is an existing position over the trolley where the drum is capped

Vacuum and condenser

Each circuit has its own vacuum and condensing system. They are skids mounted, then additional circuits may be easily implemented. A water ejector achieves the vacuum, which work with a cold water closed circuit. The ejector effectiveness has shown to be suitable for the vacuum required (working pressure 40-60 mbar).

The condenser is cooled by chilled water from the outdoors cooling equipment. For better performance during process, the condenser discharges directly to a small tank at the working condenser pressure to avoid vacuum loss.

Cooling equipment

It is a standard cooling equipment, but with additional communication interlocks in order to protect the system if a trip occurs.

The temperature of the fluid (water-glycol) in operating conditions is around 4°C.

Control panel

The process is fully automatic once an empty drum has been positioned in the trolley. Most of process variables are registered in a data logger and a complete process information is available. The whole control is managed by a Programmable Logic Control (PLC) and a PROFIBUS distributed control.

PROCESS DESCRIPTION

Introduction

The process philosophy has been agreed with the customers. They require paying as less as possible attention to the process, no operators around the panel in normal operation and only anomalies (trips or incidents) will be signalised in Control Room.

All operations, except putting the drum inside and taking it out, will be done automatically.

Drum filling

After a tightness test the drum is filled by vacuum from the concentrates tank. Operation level is reached and the process start.

Drying cycle

The drying cycle begins. The drum heating is switched on, as well as cabin air recirculation system. The condenser initiates to discharge water to the condensate tank. When the low level drum set point is reached, a new filling cycle starts. The range from low to high level is in between 10-20 litres. The process increases waste concentration but drum level is almost constant during all drying process.

When the drying is finished and the drum is taken out from the drying cabin, the 130-l drum is automatically capped and introduced into a 200 litre shielded drum. Fig. 3 shows a drying drum view with borated waste (under process) and the final sketch configuration.

CONCLUSIONS

- In drum drying process will reduce the amount of concentrates cemented waste of four Spanish Nuclear Power Plants

- The process runs automatically and values of 6 litres/hour evaporation, per drum or circuit are reached by ENSA's process.
- Final package is accepted by ENRESA

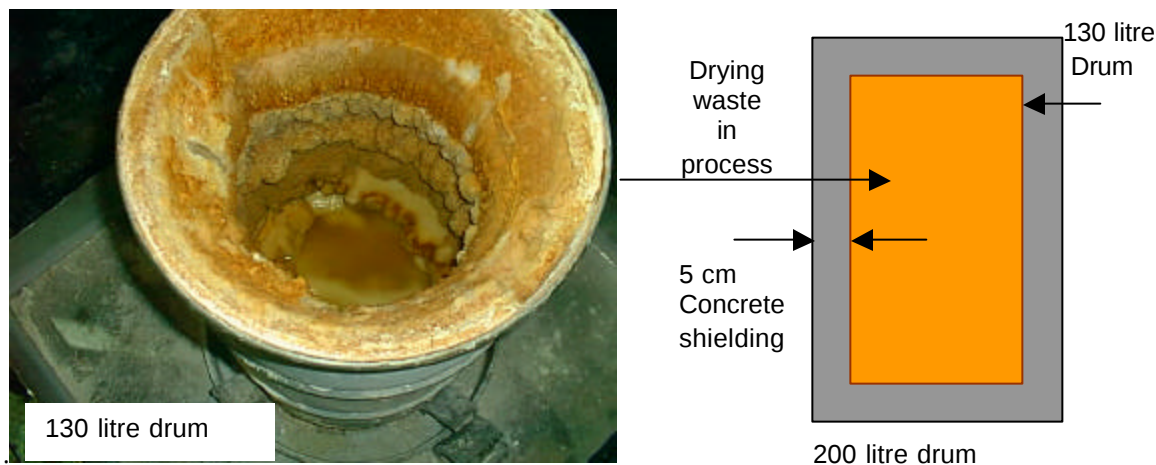


Fig.3 Drum in drying process and final packaging configuration as 19GO ENRESA's code

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