

## Xylene Chemical Recycling using A3 Problem Definition Tool

### Royal Hospital, Ministry of Health of Oman

#### Demographic information :

The Royal Hospital is the largest government tertiary hospital in the Sultanate of Oman with more than 1,100 beds and 3925 staff. It is located in the capital, Muscat, which is the second largest governorate in the country with a population of 1,623,000, accounting for 27% of the total.

Royal Hospital provides specialist and super specialist care of the highest standard. It includes a specialised cardiac centre, oncology centre, diabetic centre and a genetic and metabolic centre. The hospital is ACI (International Accreditation Canada) accredited.

#### GGHH agenda goals

- Waste

#### Case study summary

The hospital's goal was to create a process to recycle Xylene and to minimize carcinogenic and toxic waste. A large volume of Xylene is used daily by the Histopathology Department for tissue staining purposes. Once used it is then designated as hazardous waste.

#### The issue

Xylene is an aromatic hydrocarbon used in the histopathology laboratory in tissue processing, staining and cover slipping. It is a very hazardous chemical and carcinogenic. It cannot be disposed in regular sewage as it leaks into the soil, surface water or groundwater where it remains for months. It requires special treatment before disposal.

The hospital had to procure and handle large quantities of the chemical, provide storage in the laboratory by arranging large drums and finally arrange transportation for waste disposal through the hospital.

#### Hospital goals

- Reduce the volume of hazardous waste
- Reduce Purchasing Cost: Each Bottle of Xylene cost 4.900 OMR (12.76 USD) and the orders went from 720 in 2017 costing 3,528 OMR (9,172 USD) to 70 bottles in 2021 costing 343 OMR (891 USD)
- Reduce Transportation cost : Less drums were required to be stored and then collected for disposal so the frequency of collection and cost was reduced
- Save Laboratory space

## Sustainability strategy implemented

The strategy is to achieve waste minimisation through procuring a recycler (Pro cyclcer B/R Instruments ) for the histopathology department. The recycler was bought as an outright purchase item. It cost 12,900 OMR (33,540 USD ). Taking into account purchase and transport savings , it is estimated to cover the recycler cost in approximetly 8 years.

## Implementation process

The study involved the Directorate of Laboratory Medicine & Pathology, Department of Histopathology & Cytology. **A3 Lean management tool ( Plan , Do , Check , Act ) was applied .**

The Head of Department, Dr Fatma Ramadhan, and Chief Biomedical Scientist, Warda Anwar, initiated the process and contiously monitor progress.

## PLAN

1. Initial Condition
  - Storage / Safety  
High quantities of hazardous material present in the laboratory
  - Space Constraint: 8 drums per month
2. Discarding of Chemical: Several Steps
  - Annual contract with national oil company
  - Annual contract with Transport Company
  - Requires multiple approvals: hospital, Ministry of Environment, transport companies
3. Purchase requirements
  - Purchase licenses for all parties
  - Multiple steps from request to tender to selection and delivery

## DO

Introduction of Pro – Cyclcer to the system

The idea was proposed to hospital management and specifications tendered on 01/01/2018. Selection was based on cost, ease of use, safety and quality of the recycled product.

A location was identified in the histopathology laboratory store area. Initial trial period was from 01/03/2018 to 04/05/2018 and fully implemented from 01/06/2018. The recycler uses the Xylene boiling point for separation and is conducted every Thursday by trained technical staff. The supplier of the equipment conducted training for select staff.

### Check: Initial phase

- Initially small quantities of Xylene were recycled
- These recycled quantities were only used in cleaning cycles and end process of staining and not on patients' samples initially
- Quality check methodology was applied as per manufacturers recommendation

### Check: Implementation Phase

- Reduction of number of drums required for storage and disposal
- Reduction in orders of the pure chemical
- Utilize recycled chemical
- Reduction in transportation costs
- Space created
- Movement of workers from the disposal company was minimized

### Tracking progress

#### ACT:

- Track annual cost savings which reflect in savings of the last five years (1 OMR = 2.6 US Dollars)

### Progress achieved

The progress achieved during 2017-2021 is presented in the following two tables.

Year	Quantity of Xylene Bottle Orders	Price
2017	720	3,528 OMR / 9,172 USD
2018	350	1,715 OMR / 4,459 USD
2019	260	1,274 OMR / 3,312 USD
2020	154	754.6 OMR / 1,960 USD
2021	70	343 OMR / 891 USD

*\*\*note: 2017- pre pro-cycler machine*

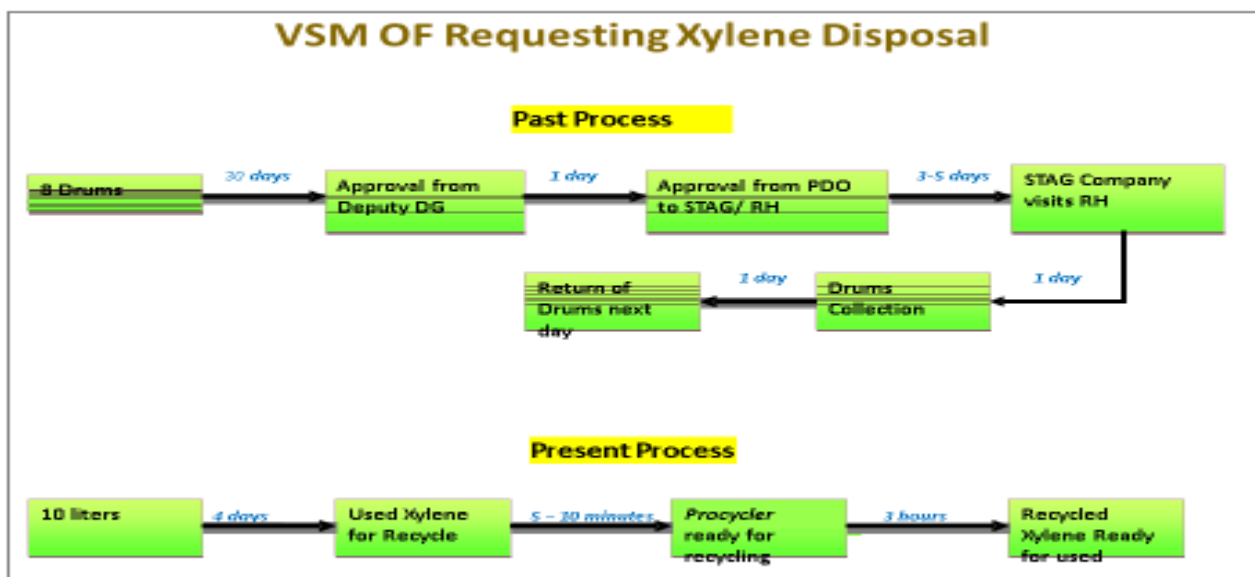
*Please note that the information in this case study was provided by the GGHH member named above. Health Care Without Harm (HCWH) is not responsible for the accuracy of the information/data provided.*

Year	Number of Drums required for Storage and disposal of Xylene (Volume 25 liters)	Total amount liters
2017	160	4,000
2018	54	1,350
2019	40	1,000
2020	13	325
2021	06	150

\*\*note: 2017- pre pro-cycler machine

## Challenges and lessons learned

- Process for disposal has been significantly simplified as in the following flowchart:



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## VSM –Value stream mapping

- Beneficial as even during the recent lockdowns in the COVID-19 (SARS-CoV-2) pandemic transportation of waste would have been interrupted causing more waste storage requirement.
- Other departments with hazardous waste problems may explore this solution.

However If the Project is to be advanced to include more chemicals or offering the service to other institutions then space will need to be provided.

## Next Steps

- Introduce alcohol, wax, and toluene for recycling.
- Explore option to recycle for other institutions and potential for creating additional income for the hospital.

## Links

<http://www.bms.com/assets/bms/us/en-us/pdf/greener-hospitals.pdf>

<https://brinstrument.com/fractional-distillation/xylene-alcohol-recycling>