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Research Article

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Valorization of liquid chemical wastes of laboratories of hospitals case of laboratories Anatomy-Pathology

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ABSTRACT

The objective of this work is the valorization of liquid chemical waste from laboratories Anatomy-pathology of a hospital by regeneration. So we proceeded to the separation of the contents of these releases by simple decantation and submit the result of the settling distillation.

Keywords: chemical liquid waste, valorization, regeneration, distillation, décantation.

INTRODUCTION

Generally, medical analysis laboratories or research use several types of chemicals products such acids, bases, solvents, coloring agents,...Waste from these laboratories must be recovered in special containers awaiting their treatment before any evacuation or recovery and purification of chemical compounds for their re-use. The regeneration of certain products from these chemical releases is done through several methods namely solvent extraction [1], flotation [2].

In our case, the mechanisms are essentially based on settling and distillation, simple and inexpensive means for the recovery and purification of some solvents [3].

Our study site, the laboratory of Anatomy Pathology of the Hospital Specialties-Rabat (HSR), uses during manipulations the following sol vents used as reagents [4] :

- Toluene: methyl benzene or phenylmethane which is one aromatic hydrocarbon used as solvent for the preparation of histological cups;
- Formol: It is a very reactive toxic aldehyde [5] for the preservation and fixation of anatomical parts,
- Ethanol: used to dehydrate the anatomical parts,
- Colouring agents: Haematein, eosin, silver chloride
- And some acids (citric acid, acetic acid ...).

EXPERIMENTAL SECTION

1-Methods of valorization liquid waste

It seems interesting to note that the effluents of the laboratories of anatomy-pathology present two phases: an aqueous and one organic.This is due to the nature of the activity of this laboratory which employs organic solvents in addition to the aqueous solutions applied to anatomical parts. Thus, the separation of the two phases observed in photo1, is made by simple decantation.The separated organic phase is then subjected to the distillation.

Photo1- Releases of Anatomy Pathology laboratory

1.1 Décantation

To carry the separation of the two phases of the rejection of anatomical pathology laboratories, we carried out a wash that rejection by tap water. After 7 minutes, we obtained two phases which are easily separable in consequence of the difference in their densities. The clear organic phase is recovered and dried by adding sodium sulfate (dessicant) and then distilled.

1.2 Distillation

The distillation is a method of separation based on the difference of boiling point of various liquids which compose a mixture. In some cases, better than a separation, there is a method of purification. If we warm a mixture of fluids, the most volatile liquid which has a boiling point (bp) lowest evaporates first. The vapors thus obtained are recovered by condensation with a water cooler. Figure 1 shows the experimental device generally used in the distillation technique [6], the photo 2 shows the editing realized in the laboratory.

Photo2-Assembly of the distillation

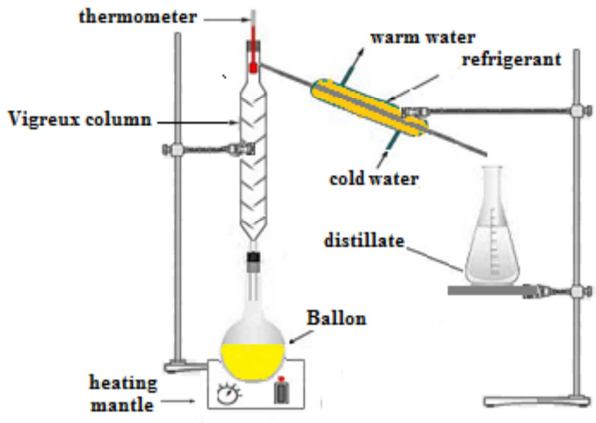


Fig. 1 Schematic of the experimental device of the distillation in laboratory

1.3 Study of the purity of solvents collected after distillation

The distillation of the liquid effluents of the laboratory of anatomy-pathology of the HSR allowed the recovery of products with various boiling points equal to 79°C, 98°C and 110,5°C which corresponds respectively to ethanol, formol and toluene.

To confirm these results, we subjected the solvent recovered to boiling point 110,5°C to the analysis by spectroscopy will infra red [7] and chromatography gaseous phase coupled with the mass spectrometry [8]. The results of these analyses will be compared with those of toluene pur and available in the laboratory of anatomy-pathology of the hospital.

RESULTS AND DISCUSSION

2-1 Results of the distillation of the rejections of anatomy pathology (RAP)

In a first stage, we made the distillation of 560 ml of the solution obtained after settling of the rejection resulting from the preparation of the anatomical rooms with the toluene as the solvent. The figure 2 shows the curve of variation of the boiling point according to time.

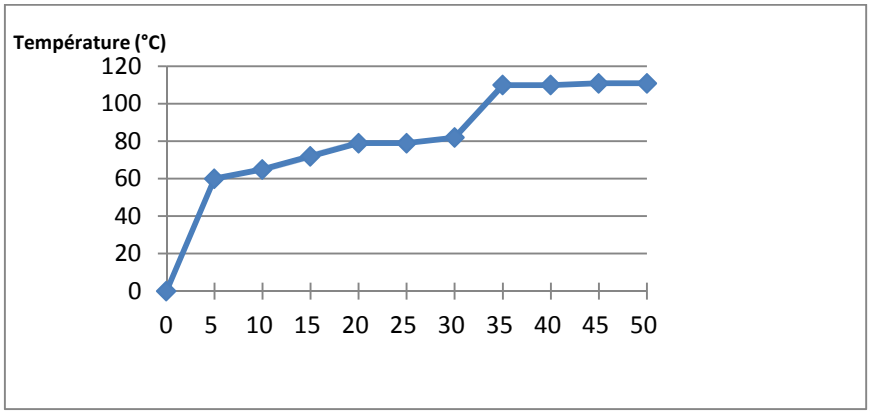


Fig.2: Curve of variation in the temperature according to time during the distillation of the organic phase of the rejection of Ana-Path (RAP)

There are three parts:

- first part (between 0-5min): the temperature reached 60 ° C and observed the first drops of liquid after condensation of the steam.
- second portion (between 5-35min) the boiling temperature ranges from 60 to 110 ° C, the obtained product is regarded as bottom product in this case.
- third portion (between 35-50min): boiling temperature stabilizes at 110.5 ° C, the recovered product can be considered as toluene.

In a second step was conducted under atmospheric pressure distillation 500ml rejection yellowish (Photo 1). The variation of the temperature during the distillation is identical to the preceding. Condensation began after the first minutes (5min) but the boiling temperature stabilized at 97 ° C for 15 min and then increased to 110.5 ° C until the end of the distillation which lasted 45min. 500 ml of the distilled liquid discharge, there was obtained 460 ml of liquid at 110.5 ° C 92% of the recovered product.

In a third step, we realized the distillation of liquid discharge anatomical pathology pinkish color (photo 1).Figure 3 below shows the trace operation of the distillation of rejection RAP pinkish color.

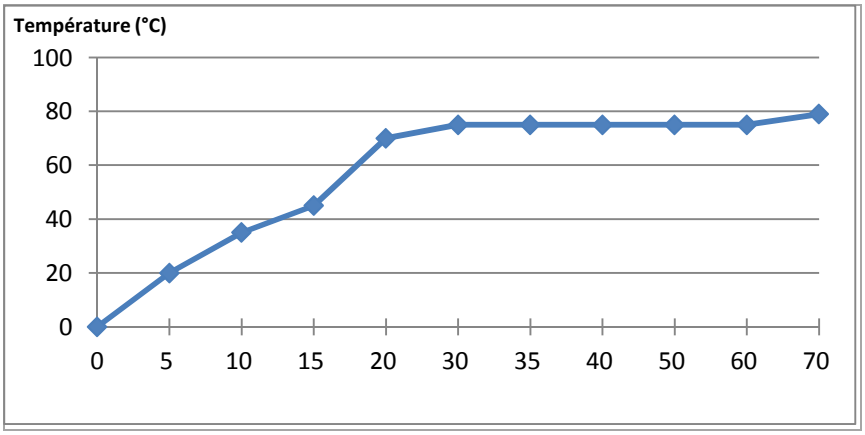


Fig.3: Tracking the distillation of rejection PAR pinkish color

These results show that the curve has two parts:

- First part (between 0-20min): the temperature increases gradually up to 70 ° C. The liquid obtained in this case is called as a bottom product.
- Second part (between 20-70min): boiling temperature stabilizes at 75 ° C for 30 min and reached 79 ° C at the end of the distillation. The recovered product can be compared to ethanol whose boiling temperature is 79 ° C.

We carried out the distillation of the product of tail collected during the first distillation at the boiling point ranging between 60 and 100°C. Distilled volume is 100ml. It is noticed that 60ml collected of this volume is obtained at a boiling point stabilized during 10 minutes with 98°C over one total duration of 20min.

In conclusion, the distillation of the rejections of the laboratory of anatomy-pathology of the HSR allowed the recovery of products at various boiling points, we distinguishes:

- one product at boiling point between 75°C and 79°C;
- a second product at boiling point between 97°C and 98°C;
- a third product at boiling point 110,5°C.

It appears that these three products obtained are the solvents used in handling of this laboratory, namely ethanol (79°C), formol (98°C) and the toluene (110,58°C) whose boiling points correspond to those of the three known products mentioned.

To confirm these results, the liquid recovered after distillation at boiling point 110,5°C and the pure toluene whose boiling point is of 110,58°C are analyzed by red Infra spectroscopy (STIF) and by chromatography gas phase (CPG) coupled with the mass spectrometry.

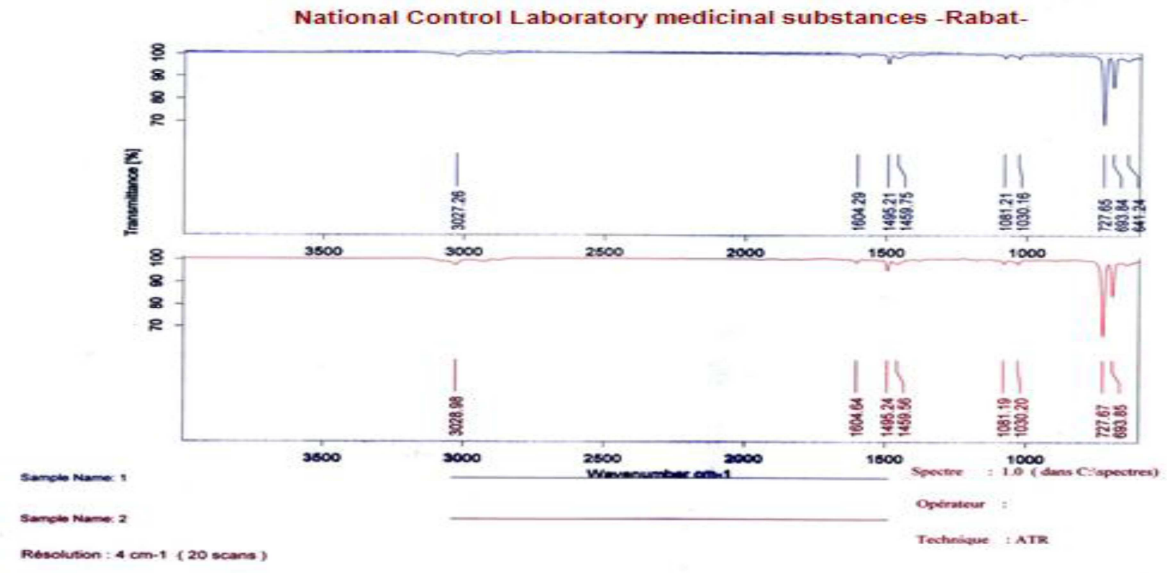


Fig.4 Separate spectra of transmittance according to the number of wave (pure toluene is Sample Name1, condensed liquid at 110,5°C indicated by Sample Name2)

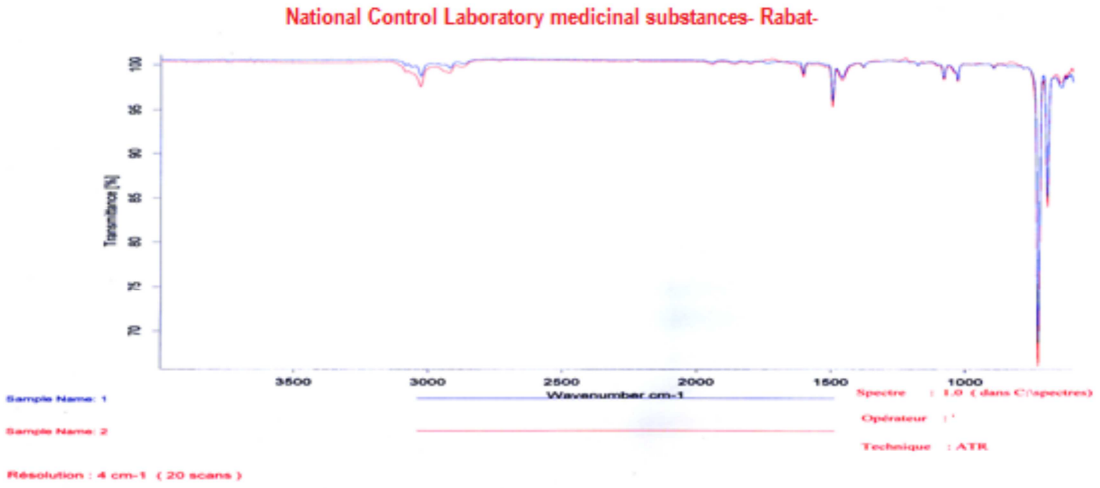


Fig.5 Superposed spectra of transmittance according to the number of wave (pure toluene indicated by Sample1, condensed liquid at 110,5°C by Sample2)

2-2 Résultats de la Spectroscopie Infrarouge(STIF)

Figures 4 and 5 shows the infrared spectra of pure toluene and the liquid recovered after distillation respectively indicated on the figures by Sample Name1 and Sample Name 2.

The comparison of the spectra obtained makes it possible to conclude that the condensed liquid at temperature 110.5°C is Toluene seen that the peaks of vibration of the molecules constituting the two liquids analyzed overlap.

2-3 Results of the Chromatography Gaseous Phase

Figures 6 and 7 show the results of the analysis by gaseous chromatography coupled with the spectroscopy of mass of pure toluene and that recovered at 110,5°C respectively represented on figures by GC01 and gc02. It should be noted that the shift of times of retention (RT) between the chromatogram of pure toluene and that of the condensed liquid with 110,5°C during distillation is mainly due to the manual injection products during the chromatography.

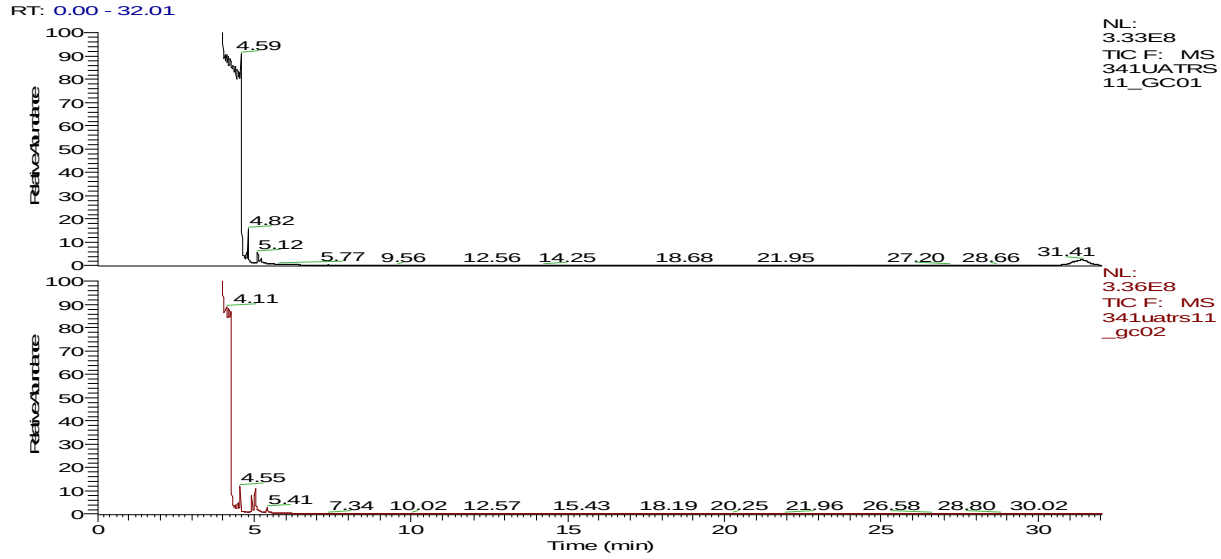


Fig.6 Chromatograms of pure toluene (GC01) and the condensed liquid with 110,5°C (gc02)

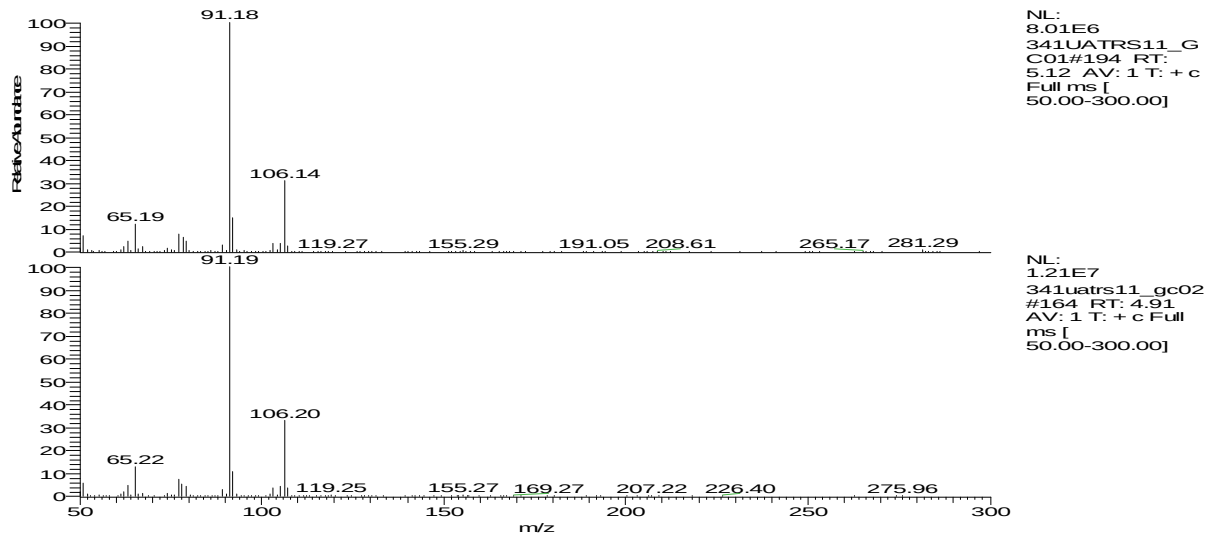
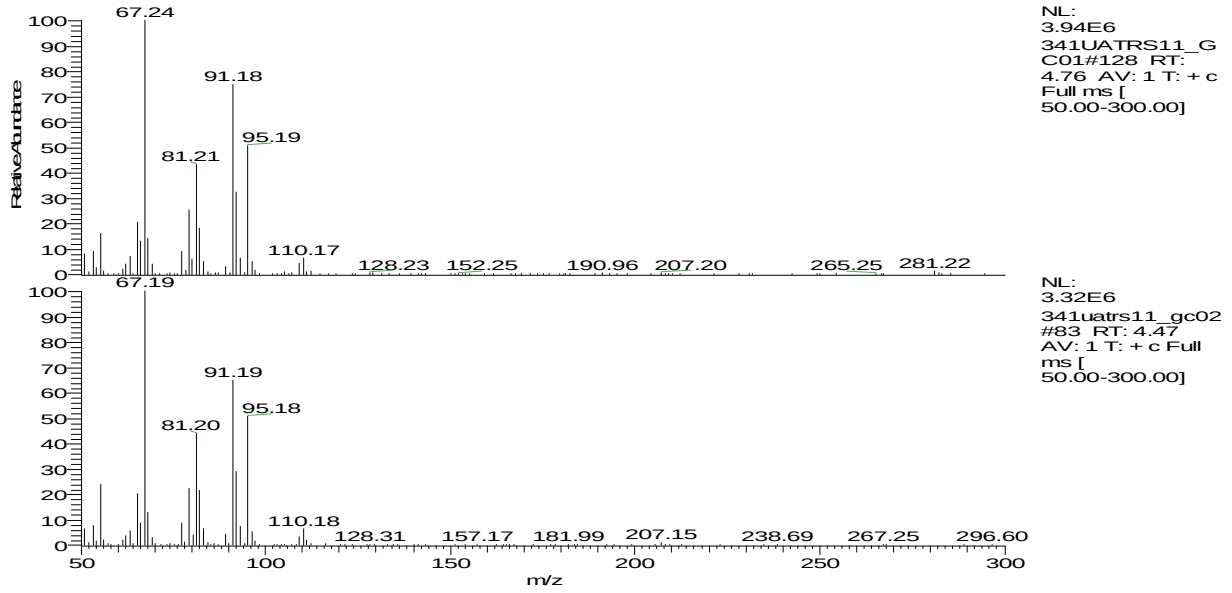


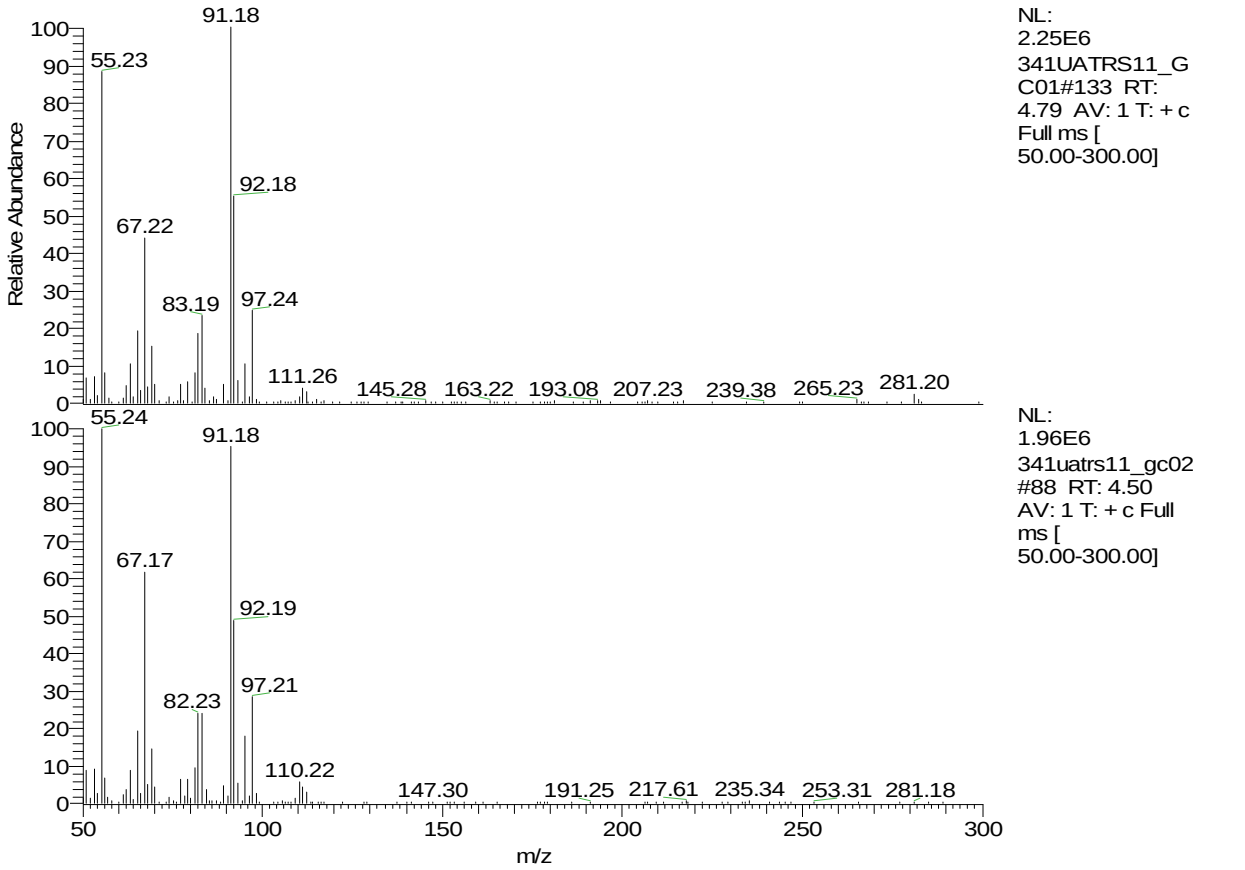
Fig.7 Mass spectra of pure toluene (GC01) and the condensed liquid 110.5 ° C (gc02)

It should be noted that the shift of times of retention (RT) between the chromatogram of pure toluene and that of the condensed liquid with 110,5°C during distillation is dù mainly to the manual injection of the products during the chromatography.

In addition, it is noted that the chromatogram gc02 is similar to the GC01.Ils chromatogram are characterized by the same majority product which is toluene. Figure 7 represents the spectra of mass of the analyzed samples, the molecular peak 91 represents toluene.

These results confirm those obtained by infra-red spectroscopy and show that the condensed liquid 110.5 ° C is toluene. Further analysis of the spectra recorded at different retention times listed below:





The results of the gaseous chromatography of the toluene (GC01) and some liquid resulting from the distillation (gc02) in various times of retention RT shows the similarity of the molecular peaks of both samples GC01 and gc02.

CONCLUSION

The study has identified the following conclusions:

• The analysis by infra red spectroscopy showed that the transmittance spectra of the recovered product to the boiling point 110.5 ° C by distillation of the studied chemical releases coincide with the spectra of pure toluene analyzed.

• Gaseous Chromatography analysis coupled with mass spectrometry shows the chromatograms of the condensed liquid at 110.5 ° C have the same chemical characteristics (molecular peaks).

These results confirm that the condensed liquid at boiling point of 110.5 ° C is the toluene which we can re-use in new manipulations of the laboratory of Anatomie-Pathologie.

This present study has for main objective the proposal of methods of regeneration of certain solvents used in manipulations realized in the laboratories of the hospital or similar establishments. Means employed are simple and not expensive, and enrolling in a double challenge such the protection of the environment and the optimization of the resources.

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