An Embedded System based Computer Controlled Process Automation for Recovery and Purification of ^{99m}Tc from (n,γ)^{99}Mo

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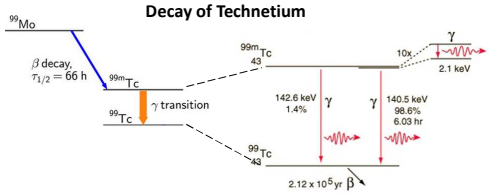
^{99m}Tc is used in 80% of diagnostic radiopharmaceutical as:

- ❖ The emitted 140.5 keV γ, can be readily detected by medical equipment.
- ❖ Its multi-oxidation states (-1 to +7) allows production of various complexes with desired characteristics.
- ❖ Its "short" physical half-life (94% of it decays to ^{99}Tc in 24 hours) allows for scanning procedures which collect data rapidly, but keep total radiation exposure to patients low.
- ❖ Its final conversion to Ru by soft β^- decay without a γ emission is desirable feature for radiopharmaceuticals.



Conventional methods of separation include:

1. Alumina Column Chromatography
2. Zirconium Molybdate Gel Column Chromatography
3. Solvent Extraction – Current (manual) method followed in hospitals in India & other developing countries.

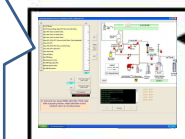
Problem of current method:

1. Evaporation of inflammable MEK by heating is hazardous & environmentally polluting.
2. Possibility of bacterial contamination in the product.
3. Radiation exposure to the operating technicians.
4. Requirement of fume hood & skilled technicians may not always be practically feasible for Hospitals.
5. Cumbersome.

Solution: Automated close cyclic module (AUTOSOLEX) with adequate safety features.

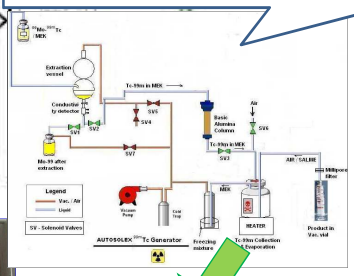
PC based GUI allows user to

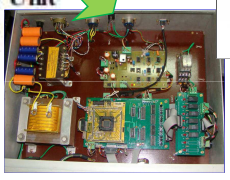
1. Program process parameters
2. Operate on the Process
3. Monitor Status
4. Log Data with Timestamp
5. Prompt users to intervene



Process chemistry

- Selective extraction of $^{99m}TcO_4^-$ in MEK from aqueous alkaline (n, γ)$Na_2{}^{99}MoO_4$
- Purification of organic phase by passing through an alumina column
- Evaporation of organic phase
- Reconstitution of residue in physiological saline (10 ml)
- Purification through 0.22μ membrane filter
- Pharmaceutical grade ^{99m}Tc collection in a vacuum vial





16-bit μcontroller based Electronics: Features & Functions

1. Fail-safe programmable Interface linking Remote operator to Process chemistry
2. Serially communicates with PC according to defined protocol for
   - i. Configuring process parameters
   - ii. Operating on actuators via isolated driver
   - iii. Status monitoring
3. Conductivity Detector automates separation of chemical phases
4. Temperature regulated heating module achieves controlled evaporation of organic phase
5. Local status display by front panel LEDs

Benefits

1. Simple to operate but enforces strict adherence to embedded protocol, eliminating chances of procedural error.
2. Less chance of radiation exposure to operators.
3. Conductivity detector ensures less chance of ^{99}Mo contamination.
4. Reuse of MEK after each cycle excludes disposal problem.
5. Online display of system status for remote operator.
6. Cheap.
7. After each extraction cycle, a fresh cycle can be started on the same day.
8. Absence of volume restriction.
9. Communication log display & time-stamped background log eases fault diagnosis.
10. Modular design allows easier upgradation and maintenance.

Scope

- •High potentiality for its application in nuclear medicine centre.
- •Can be used for separation of ^{99m}Tc directly produced from ^{100}Mo by (p, 2n) reaction in a cyclotron.
- •The design generalization allows adoption in any radiochemical separation in general and production of new SPECT/PET pharmaceuticals in particular.
- •May prove extremely useful in routine production of new radiopharmaceuticals in the upcoming medical cyclotron project in Kolkata.

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