



Benzene line: equipment, laboratory setup and staff training

Radiocarbon Dating Equipment

Conventional Radiocarbon Dating laboratory is based on Radioactivity measurement by Proportional counter or by Liquid Scintillation Counting (LSC). LSC based Conventional Carbon Dating requires modern liquid scintillation counter (spectrometer) like: QUANTULUS - Liquid Scintillation Spectrometer or Tri-Carb Liquid Scintillation Counters both produced by PerkinElmer Inc.

Modern radiocarbon dating equipment - benzene line allows sample material conversion into benzene for at least 3-4 and up to 6-8 samples per day depending of kind of sample material and corresponding pretreatment required.

Benzene line is developed for benzene sample production used as counting media for radiocarbon dating or tritium analyses. Benzene line is set of chemical equipment applied for sample preparation for conventional C-14 dating.

All it serves for Carbon dating by Liquid Scintillation Counting, when Radiocarbon activity is measured in benzene. **Small sample concept** is ability of benzene line to produce a small sample of benzene based on use variable changeable quantity of high productivity catalyst allows minimization of "memory effect".

New lab (High T set)



New lab (Low T set)



High Temperature module (scheme)

Vacuum pyrolysis

All reactions inside vessel flow, as it depends on sample condition, in one or two step without and/or with passive chemical oxidizer inside (pyrolusite). Such technology was published by Skripkin, 1998. Some recent methodical developments were included in User Manual, into introduction lectures, into equipment introduction training and into metal in recent modifications of modern set of Radiocarbon Dating Equipment - benzene line.

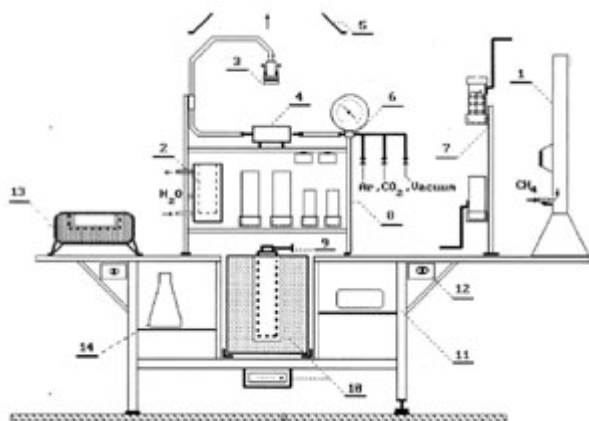
Low temperature module serves for acetylene synthesis, effective freezing, purification and compacting before benzene synthesis. High yield of acetylene conversion to benzene is achieved using of modern catalysts based on vanadium or chromium impregnated deeply into highly porous material.

Sample way to Carbon Dating by LSC Based on Vacuum line

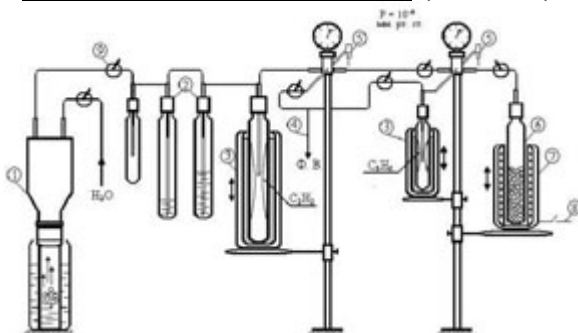
- Sample pretreatment.
- Lithium carbide synthesis.
- Acetylene synthesis by carbide hydrolyzation.
- Acetylene purification (bubbling through the solution of chromium) and cryogenic freezing.
- Catalyst activation.
- Benzene synthesis (Trimerization on catalyst).
- Benzene cryogenic freezing.
- Benzene purification by sulfuric acid extraction and sublimation.
- Benzene counting (Modern liquid scintillation

Sample material to be Carbon dated could be: (wood, charcoal, carbonate, peat, bone) and it is finally converted to C_6H_6 . Carbon Conversion of sample includes combination of procedures: charring of sample, pyrolysis, and steps of synthesis: lithium carbide, acetylene and benzene. It includes modules, working under controlled vacuum, producing of benzene. Vacuum line transports Carbon inside each of and between modules. Vacuum line is easy to be disassembled to change consumables and cleaning in case. Two main sections work in line: High Temperature ($800^{\circ}C$) and Low Temperature (up to $300^{\circ}C$), see below. Recent developments in procedures of processing sample widened approaches for preparing benzene on base of datable carbon. Stainless steel and Teflon are base materials in equipment concept.

Reaction vessel is the Heart of Radiocarbon Dating Equipment (benzene line). Reaction vessel is included in the high temperature module. It serves to synthesize lithium carbide by performing of chemical transformation reactions using Carbon of any kind of carbon containing sample material and lithium metal. It is covered with hermetic vacuumed and water cooled head and it works at $750-850^{\circ}C$ as it was described at Skripkin, 1998.



Low Temperature module (scheme)



counting).

Sample Processing of Carbon and Carbon containing Materials (Lithium carbide processing schemes):

- - Charcoal sample - carbon - carbide;
- - Carbon dioxide - carbide;
- - Organic matter or carbonates sample - carbide, in one stage, using new highly efficiency technology.

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