



Equipment for radiocarbon dating

Available Methods of Carbon Dating

Conventional Carbon Dating and Accelerator Mass-Spectrometry are two today's generally possible kinds of lab equipment and corresponding method applicable for radiocarbon dating.

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. and What kind of equipment is required for C^{14} dating?

Benzene line is developed for benzene syntheses 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.

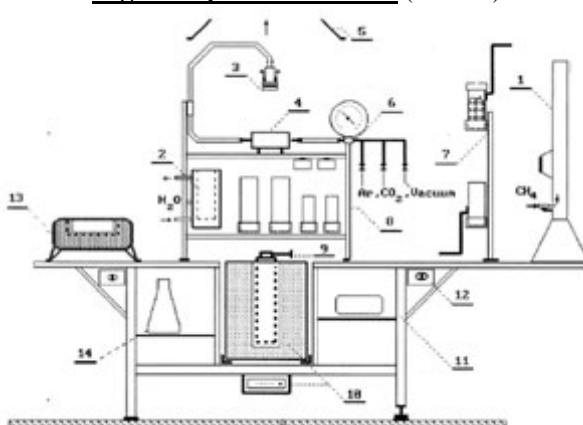
Sample material to be Carbon dated could be: (wood, charcoal, carbonate, peat, bone) and it is finally converted to C_6H_6 .

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.

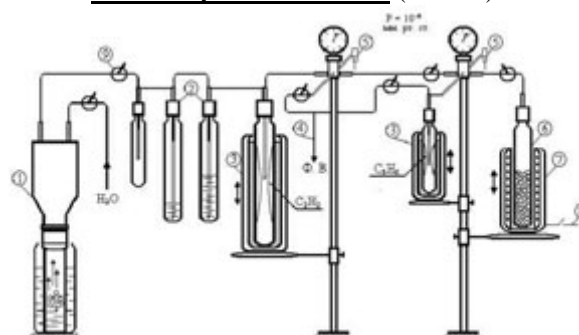
Vacuum line transports Carbon inside and between modules.

All it serves for Carbon dating by Liquid Scintillation when Radiocarbon activity is measured in benzene.

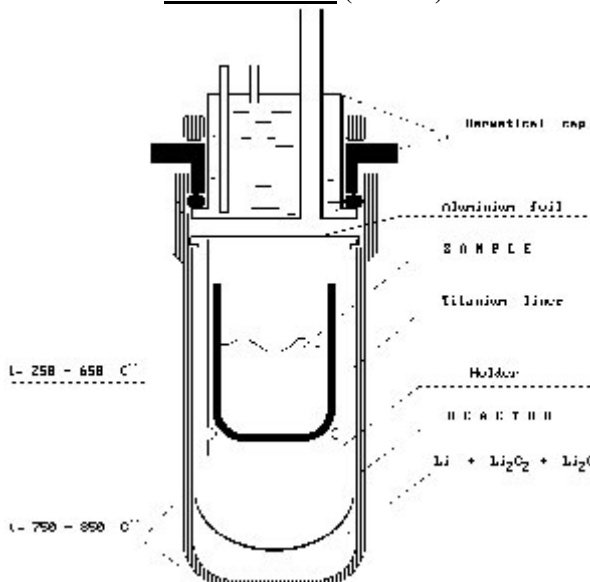
High Temperature module (scheme)



Low Temperature module (scheme)



Reaction vessel (scheme)



High temperature module Charring and Carbide production

- Chimney (Is used for transfer of smoke while wood charring to charcoal).
- Water cooling system (cooling of reactor head and cooling of reactor vessel after processing).
- Water cooled reaction vessel head.
- Air (dust) filter.
- Ventilation cone.
- Manometer.
- Additional Stand.
- Main Stand.
- Holder of Reaction Vessel.
- Vertical Oven (up to $1000^{\circ}C$).
- Holder.
- Control unit (temperature).
- Plate Oven.
- Cone Reaction vessel.

Low temperature module

Acetylene & benzene synthesis

- Hydrolyzator,
- Two stage line for chemical purification of acetylene using chromium solution (10 % CrO_3 solution in 10 % H_2SO_4 ,
- Cryogenic trap,
- Vacuum line,
- Check valve,
- Catalyst ($Cr_2O_3 + Al_2O_3 \cdot SiO_2$),
- Oven to activate the catalyst,
- Electric grid,
- System of taps.

Reaction vessel is the Heart of benzene line - scheme corresponds to direct pyrolysis.

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 $750-$

Two main sections work in line: High Temperature (800°C) and Low Temperature (up to 300°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.

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 counting).

All steps listed above are performed in benzene line.

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.

Modern 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.

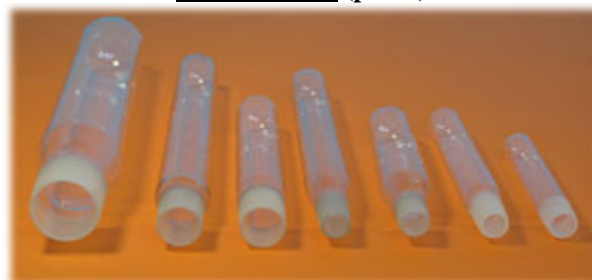
New lab (High T set)



New lab (Low T set)



Glassware Set (photo)



Contact us: benzeneline@gmail.com

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850°C as it was described at Skripkin, 1998.

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 laboratory 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.

Vacuum line is easy to be disassembled to change consumables and cleaning in case.

Small sample optimization of ability to produce a small sample of benzene based on use variable changeable quantity of high productivity catalyst allows minimization of "memory effect".

Laboratory glassware Hi Q glass

High quality tubes of three

different diameters allow

producing glass reaction vessels with cone connections.

Boron-silicate glass tubes are

used to produce laboratory

glassware applicable for all

stages of sample conversion in

benzene line.

Cone connections allow

connecting glass reaction vessels

with Teflon holders equipped

with corresponding's.

Glassware production

laboratory glass vessels, includes

following main steps: cone

formation, cone tuning,

formation of tube bottom.

Working temperature range is :

-200°C to +600°C.