



PURIFICATION, COMPRESSION AND DRYING OF ACETYLENE

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Prepared by WG-12 Acetylene

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Amendments to 241/22

Section	Change
3.2.2	Correction of table
12	Addition of sentence

1 Introduction

This document has been prepared by the European Industrial Gases Association (EIGA) to give guidance for the purification, compression and drying of acetylene.

2 Scope

This publication is intended to provide general guidelines for the purification, compression and drying of acetylene. This publication includes recommendations for operational and maintenance safe practices to mitigate potential acetylene decomposition and other hazards related to the purification, compression and drying of acetylene.

The equipment named is typical for carbide acetylene plants. In petrochemical plants similar compression and drying equipment can be used, but normally there is no purification system as this production method is not creating non-metal hydride (e.g PH₃) impurities as in carbide acetylene plants.

This publication covers equipment from the exit of the generator to the entry of the fill manifold.

The scope of this document may be seen in diagram 1 below in the blue circles.

- Purification
 - Dry or wet acidic purification (followed by caustic soda or water neutralisation)
- Compression
- Drying
 - Low pressure drier
 - High pressure drier

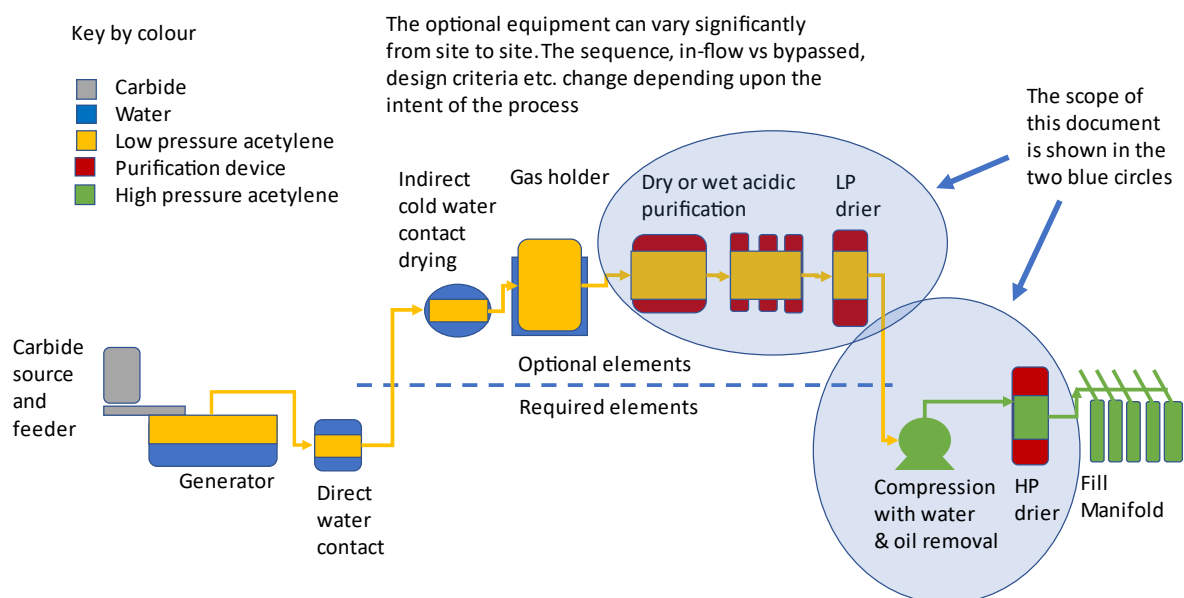


Figure 1 Overview of production process for acetylene (generated from calcium carbide)

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Hydration of acetylene

The combination of the acetylene with the moisture in the gas when the moisture is greater than saturation and the pressure/temperature of the acetylene is within a defined zone. Can lead to flow restrictions which in turn lead to increased pressure drop and hence greater (unwanted) cooling.

3.2.2 Moisture

Moisture is expressed in a number of different units. Below is a table expressing moisture in acetylene in a number of the more commonly used units.

Dew Point temp @ 1bara [°C]	moisture content by volume [ppmV]	moisture content by weight [ppmW]	Absolute Humidity [g/m ³]	Dew point temp @ 26bara [°C]
-60	11	7,4	0,008	-32,9
-50	39	27,0	0,030	-20,1
-40	127	88,0	0,100	-7,1
-30	375	260,0	0,300	6,8
-20	1.019	706,0	0,800	22,3
-10	2.565	1.776,0	2,000	38,4
0	6.032	4.176,0	4,600	55,2
10	12.100	8.377,0	9,200	70,3
20	>23.000	15.938,0	17,500	85,8

3.2.3 Pressure

In this document bar shall indicate gauge pressure unless otherwise noted –i.e., (bar, abs) for absolute pressure and (bar, dif) for differential pressure.

3.2.4 Pressure Swing Adsorption (PSA)

PSA is a technology used for removing an undesired (contaminant) gas present in a gas stream. The process is made under pressure and the contaminant is retained by an adsorbent material. The adsorbent is regenerated by reducing the pressure and using a carrying gas.

3.2.5 Dry purifying media

A typical composition is:

- 35% Diatomaceous Earth (DE Diatomite)
a naturally occurring, soft, siliceous sedimentary rock that is easily crumbled into a fine white to off-white powder
- 63% Ferrous chloride (as a 35% solution in water)
Containing impurities of ferric chloride, copper and acid
- 1.1% Copper sulphate
- 0.3% Manganese Dioxide
- 0.2% Mercury Bichloride

NOTE Trade names for this include Monkey Dust, Catalysol or Heratol

3.2.6 Temperature Swing Adsorption (TSA)

TSA is a technology used for removing an undesired (contaminant) gas present in a gas stream. The process uses thermal energy. The adsorbent is regenerated by raising the temperature of the adsorbent which acts in favour of increasing the gas desorption process.

3.2.7 ppmv

parts per million by volume

3.2.8 ppmw

parts per million by weight

4 Overview of the process

Acetylene exiting a wet calcium carbide generator is at low (< 0,2 bar) or medium pressure (< 1,5 bar) and at an elevated temperature 50°C to 90°C. The acetylene is saturated with water vapour (100 to 120 g/m³), and there are impurities – ammonia, hydrogen sulphide, phosphine (and lesser extent arsine). The purpose of the post generation equipment (low and high pressure) is to clean the gas so that it:

1. is at least 98% pure;
2. is free of impurities which would be corrosive to the materials of build of the plant, e.g acidic sulphuric compounds;
3. is free of water that would cause absorption problems for the porous material inside the cylinders;
4. has reduced phosphine and arsine impurities (for cutting and welding applications these impurities are irrelevant).

Typical values in raw acetylene from the wet generation process are:

	ppmv unless stated
Moisture	100 to 120 g/m ³
Nitrogen	3600
Oxygen	750
Argon	50
Hydrogen	350
Methane	350
NH ₃	200 to 400
Hydrogen sulphide	50 to 300
PH ₃	400 to 500
AsH ₃	3

For the product specification see EIGA Doc 240, *Commodity Specification Acetylene* [1]

For use as a flame the quantities of phosphine, arsine and hydrogen sulphide are generally unimportant to the user but for other uses such as carbon black deposition these impurities may be impactful.

The steps of the process are:

1. Water soluble impurity removal
Direct acetylene to water contact - ammonia scrubber
Function: Removal of water dissolvable components e.g. ammonia and hydrogen sulphide
Purpose: Prevention of internal corrosion of the pipes and vessels
2. Low pressure drying
Indirect cooling of the acetylene – cooler condenser
and / or
Direct contact calcium chloride driers
Function: Moisture reduction
Purpose: Less water into downstream equipment
3. Low pressure phosphine and arsine removal
Optional purification via contact with acidic compounds
 - a. Direct gas contact with dry purification material
 - b. Direct gas contact with strong sulphuric acid (afterwards neutralisation with caustic soda)
Function: Removal of phosphine and arsine
Purpose: High purity acetylene for customer processes
4. Compression
Function: Increased pressure, and some further water removal
Purpose: To be able to fill cylinders, bundles and trailers
5. High pressure driers
Function: Final dryness of gas before entering cylinders
Purpose: Removal of moisture to prevent damage to cylinders as moisture can:
 - mix with the solvent and reduce its ability to dissolve acetylene;
 - damage the porous material;
 - cause corrosion of the internal cylinder walls.

5 Impurities in Acetylene

See EIGA Doc 240 [1]