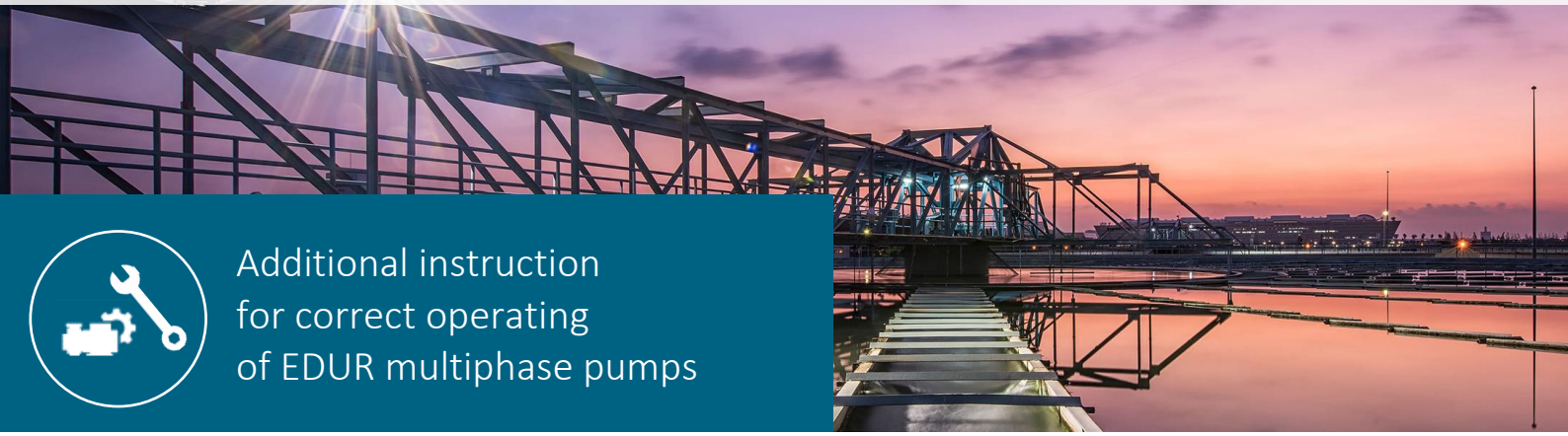


Additional instruction for correct operating of EDUR multiphase pumps

Installation

In principle installation of multiphase pump is shown below. The liquid should flow towards the pump. In order to avoid loss of liquid in case of standstill of the system the air pipe line has to lead once above the liquid level of the tank. In case of closed systems it will be necessary to install an additional non-return valve at the highest point of the gas pipe line.

Initial Starting – Gas Feeding:

1. Gas available under pressure

The pump has to be started according to para 5 of the operating instruction without gas feeding. The pump has to be adjusted at the pressure side to a point of operation with approx. 10-20% larger flowrate depending on the pump type and blading. Open the gas feeding mechanism (rotameter) slowly until the designed point of operation has been reached. For the adjustment a flowmeter and a manometer will be helpful. If necessary the point of operation has to be re-adjusted by means of the measuring instruments.

2. Gas fed without pressure

The pump has to be started according to para 5 of the operating instruction without gas feeding. The pump has to be adjusted at the pressure side to a point of operation with approx. 10-20% larger flowrate depending on the pump type and blading. At the suction side the pump has to be adjusted to a vacuum of –0,2 to –0,3 bar.

Air supply has to be opened slowly until the designed point of operation has been reached. The vacuum at the suction side sucks the air into the suction pipe. In case that the gas quantity is not sufficient the vacuum has to be increased until the necessary air quantity flows in. For the adjustment a flowmeter and a manometer will be helpful. If necessary the point of operation has to be re-adjusted by means of the measuring instruments.

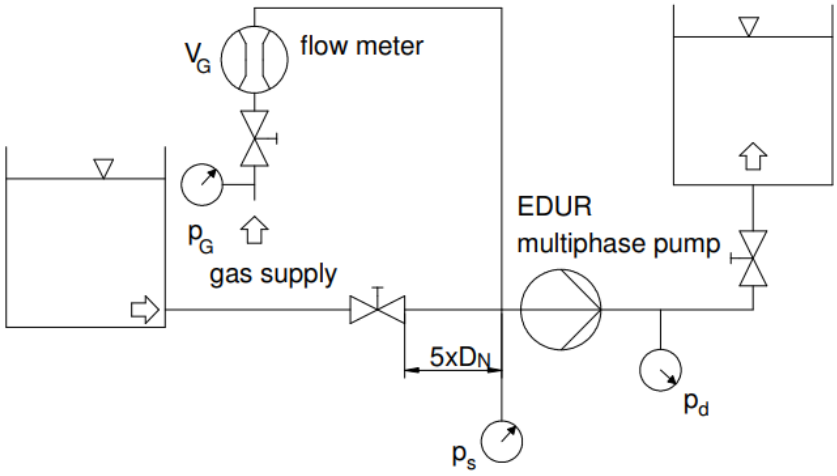
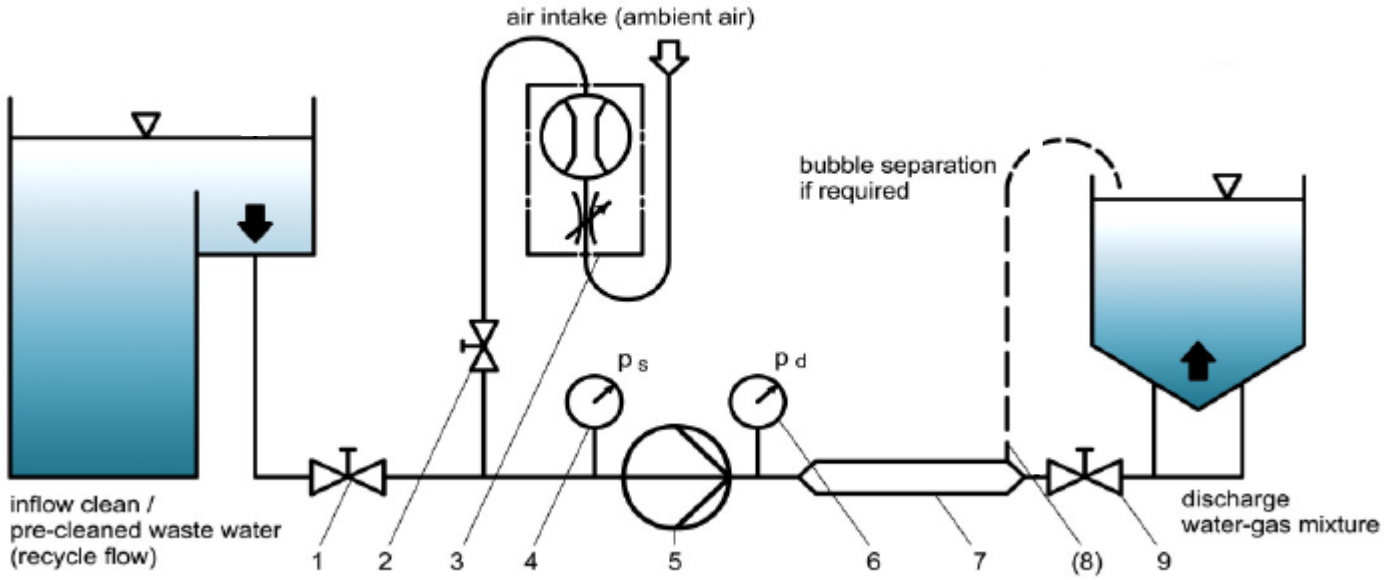


Fig. 1: Principle of installation for a multiphase pump in an open system

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com

Fig. 2: Installation and initial starting of EDUR Multiphase Pumps



1. Throttle valve for water flow at pump inlet
2. Check valve for air suction (atmospheric air)
3. Air flow measuring device with neddle valve
4. Inlet side manometer (vacuum gauge)
5. EDUR Multiphase (flotation) pump
6. Pressure side manometer
7. Solution line (may not apply for simple gassing)
8. Bubble separation (if required)
9. Pressure relief valve

General Advices for Installation of EDUR Multiphase (Flotation) Pump

- Realize inflow conditions at pump inlet side.
- Select throttle valve (1) and pressure relief valve (9) with good dosing features.
- Gas supply line guidance above highest liquid-level in order to avoid that water will attain the air flow measuring device (3).
- Select air flow measuring device (3) with suitable metering range and with needle valve for optimal adjustment of the air flow.
- Design inflow-pipe for the range of air inlet till pump inlet flange in a short and horizontal way in order to ensure that always a constant water-air proportion arrives at the pump.
- As solution line for dissolved air flotation a pipe line with corresponding larger nominal width will be suitable in order to achieve a dwell period of approx. 1 min. until relaxation. If required, surplus air can be led away by means of a bubble separation (8) at highest position before relaxation (pipe line with very small nominal width).

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com

EDUR Multiphase (Flotation) Pumps are being operated with clean or pre-cleaned water in the recycle-flow process. Therefore also during starting phase attention has to be paid to the water cleanness!

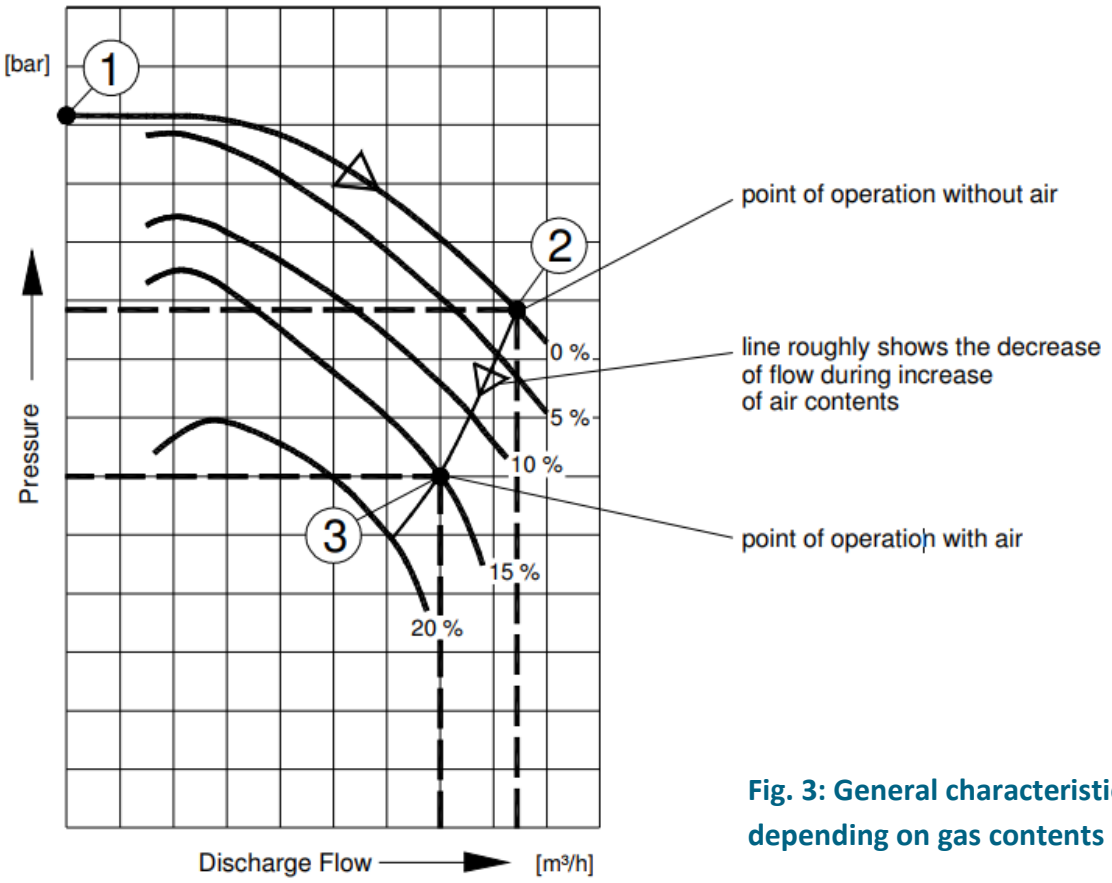


Fig. 3: General characteristic curves depending on gas contents

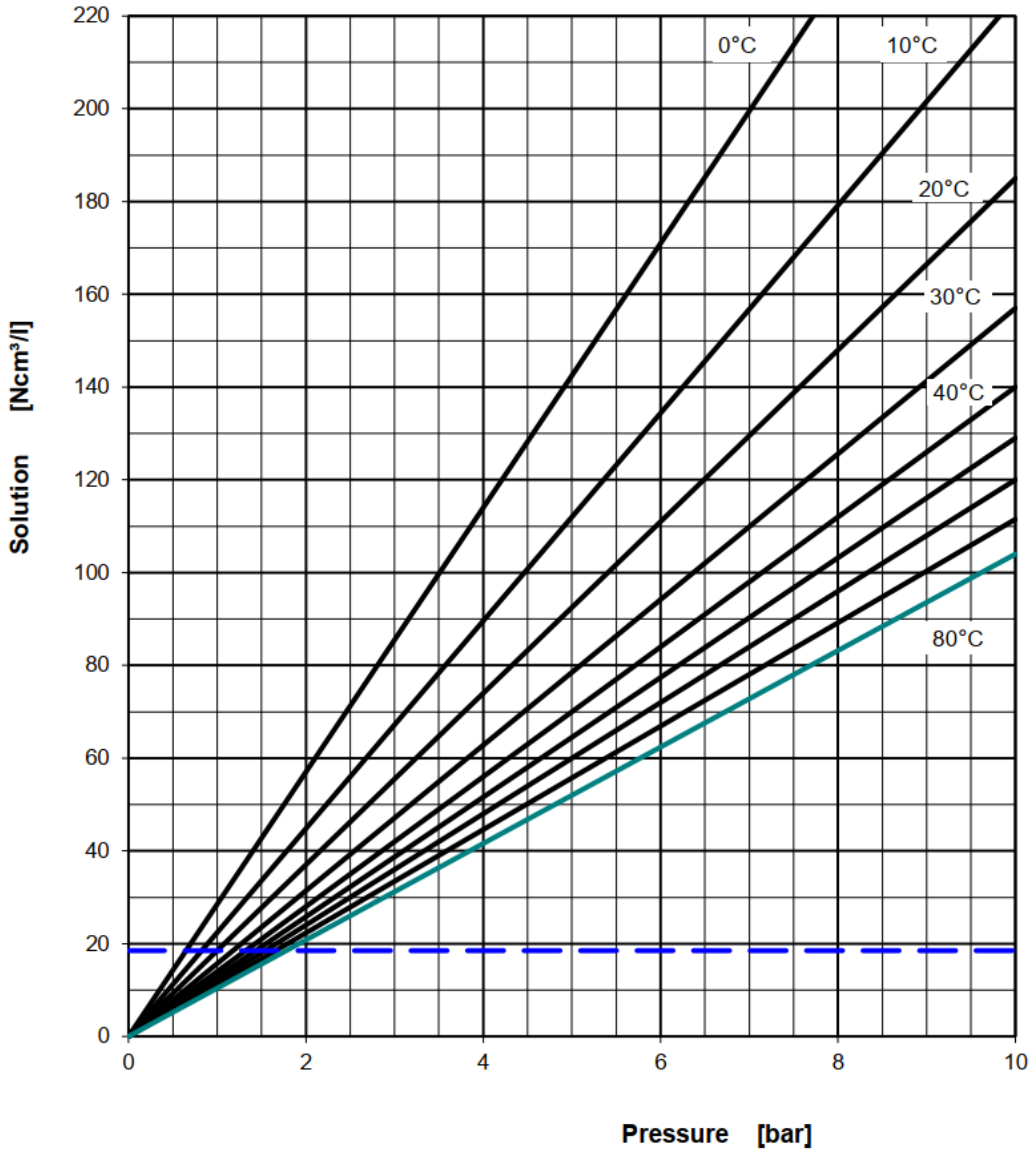
1. Initially pump has to be put into operation according to para 5 of the known operating instructions for pure water supply (without air) and to check the maximum pump pressure as per characteristic curve – point 1 (by means of short-time closing of the pressure relief valve at the pressure side – pos. 9 – while the bubble separation pipe is closed).
2. Open the pressure relief valve so far until the required operation pressure for pure water supply has been reached – point 2. At the same time it has to be considered that the flow rate for pure water supply has to be approx. 10…20 % higher than for the supply of water-gas mixtures.
3. The water flow has to be adjusted slightly at the inlet side by means of a throttle valve (Pos. 1) till a pressure (vacuum) of approx. -0,2…-0,3 bar will be achieved at the suction side manometer (Pos. 4) in front of the pump.
4. Open the air supply at the throttle valve (Pos. 2) and adjust required air flow at needle valve (Pos. 3). The operating pressure at the pressure side manometer (Pos. 6) in doing so decreases slightly to point 3 (where necessary re-adjust the vacuum at the pump inlet side in case that the required air flow will not be sucked in from the atmospheric air). In case that the delivery stops the air flow has to be reduced accordingly.

In order to avoid large bubbles the gas contents must not exceed the physically possible solubility. After the pressure relaxation (behind pressure relief valve Pos. 9) a very fine white water effect is being generated this way. Other gases also can be charged considering the solubility. Differing methods also will be possible after consulting.

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com

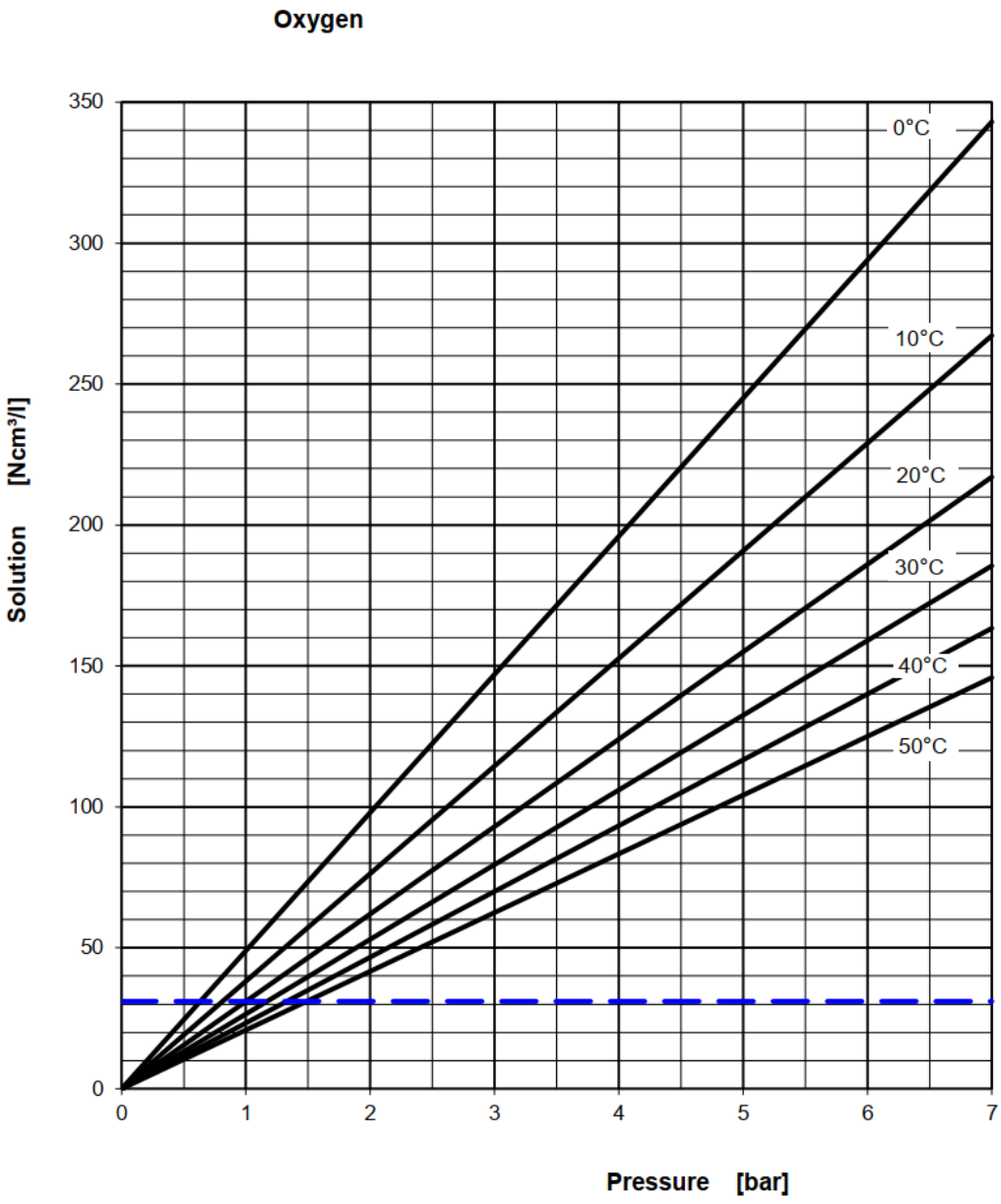
Solution of Gases in Water

Air

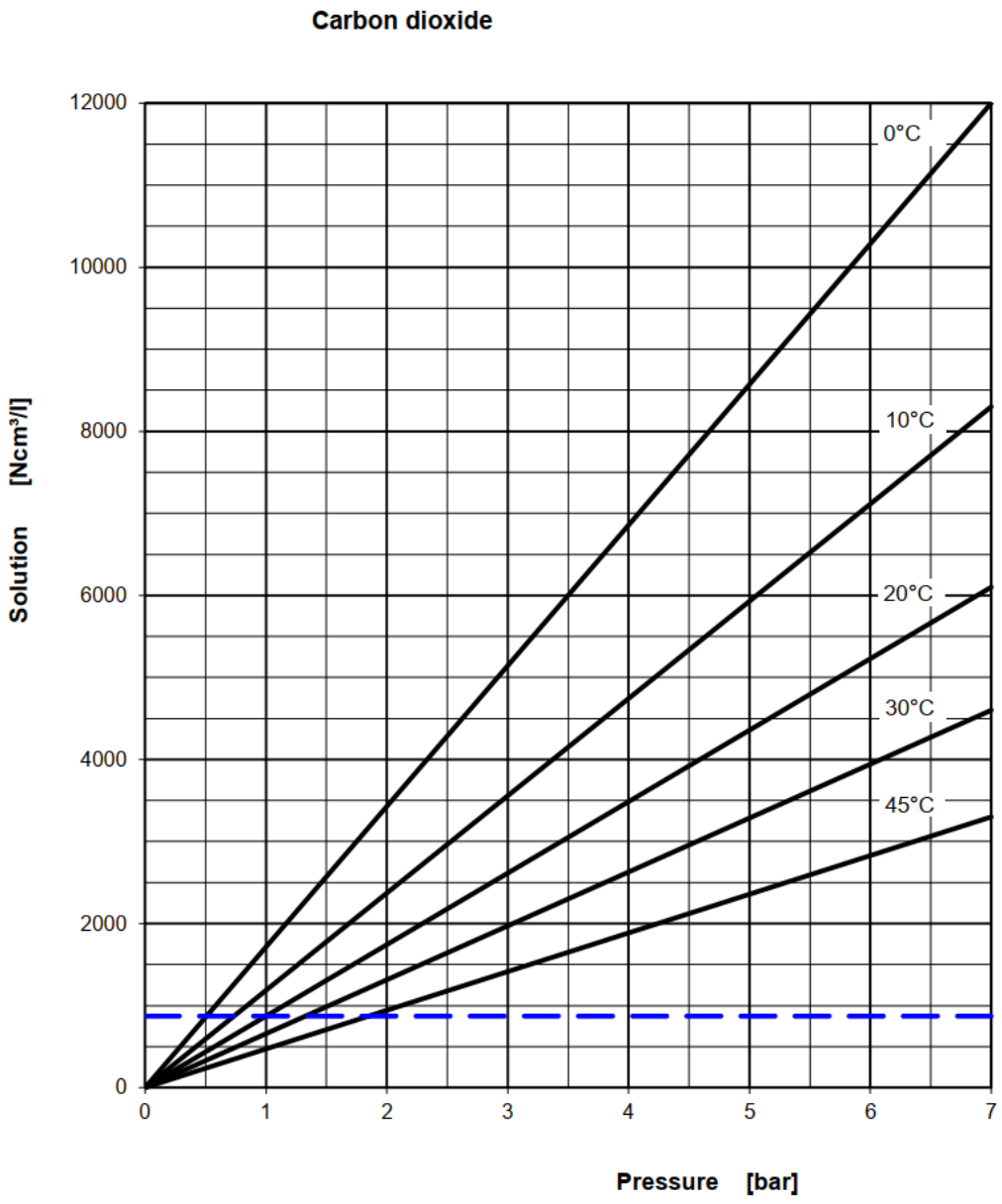


Remaining gas volume after dissolving to 1013 mbar at 20°C

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com

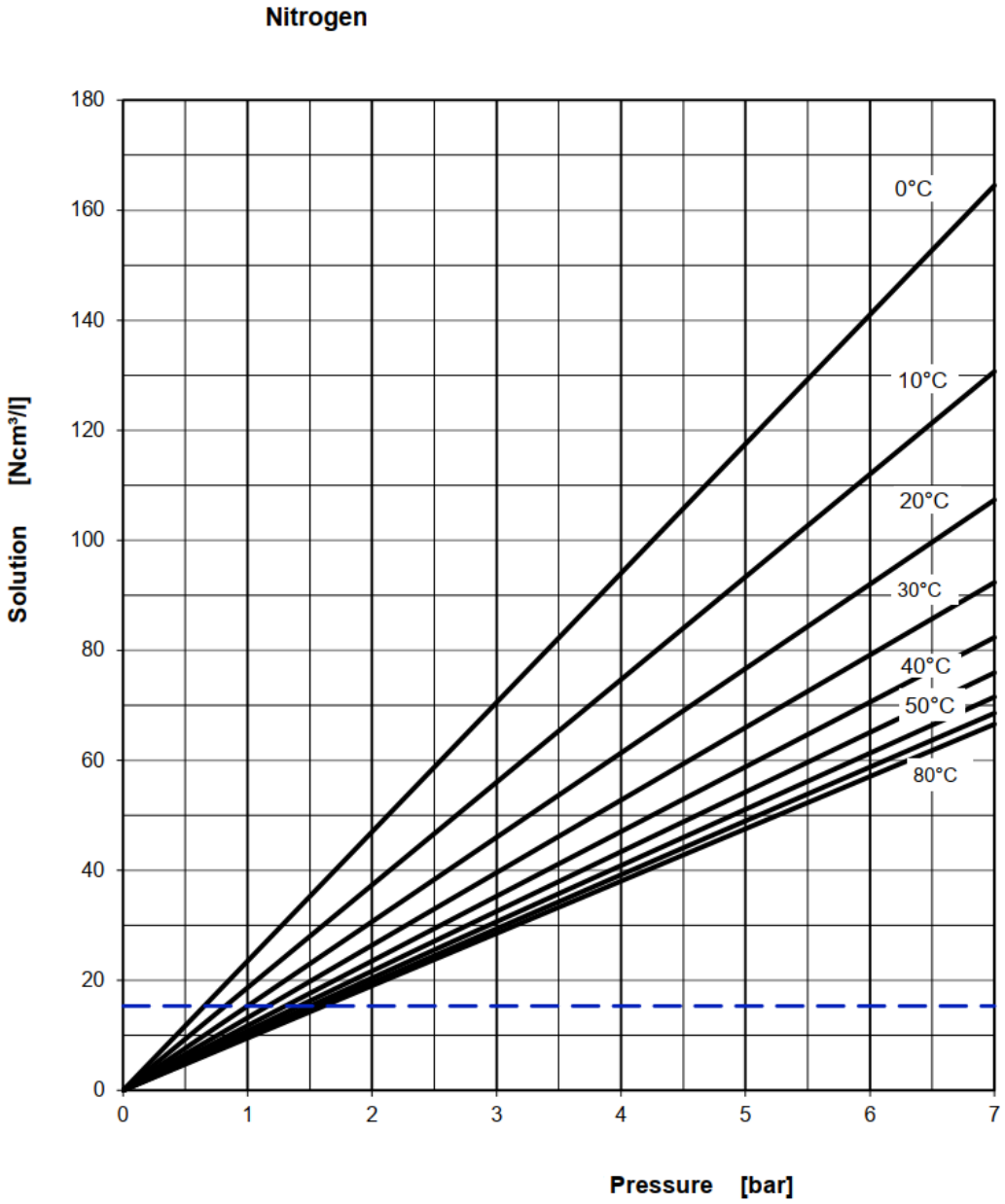


Remaining gas volume after dissolving to 1013 mbar at 20°C

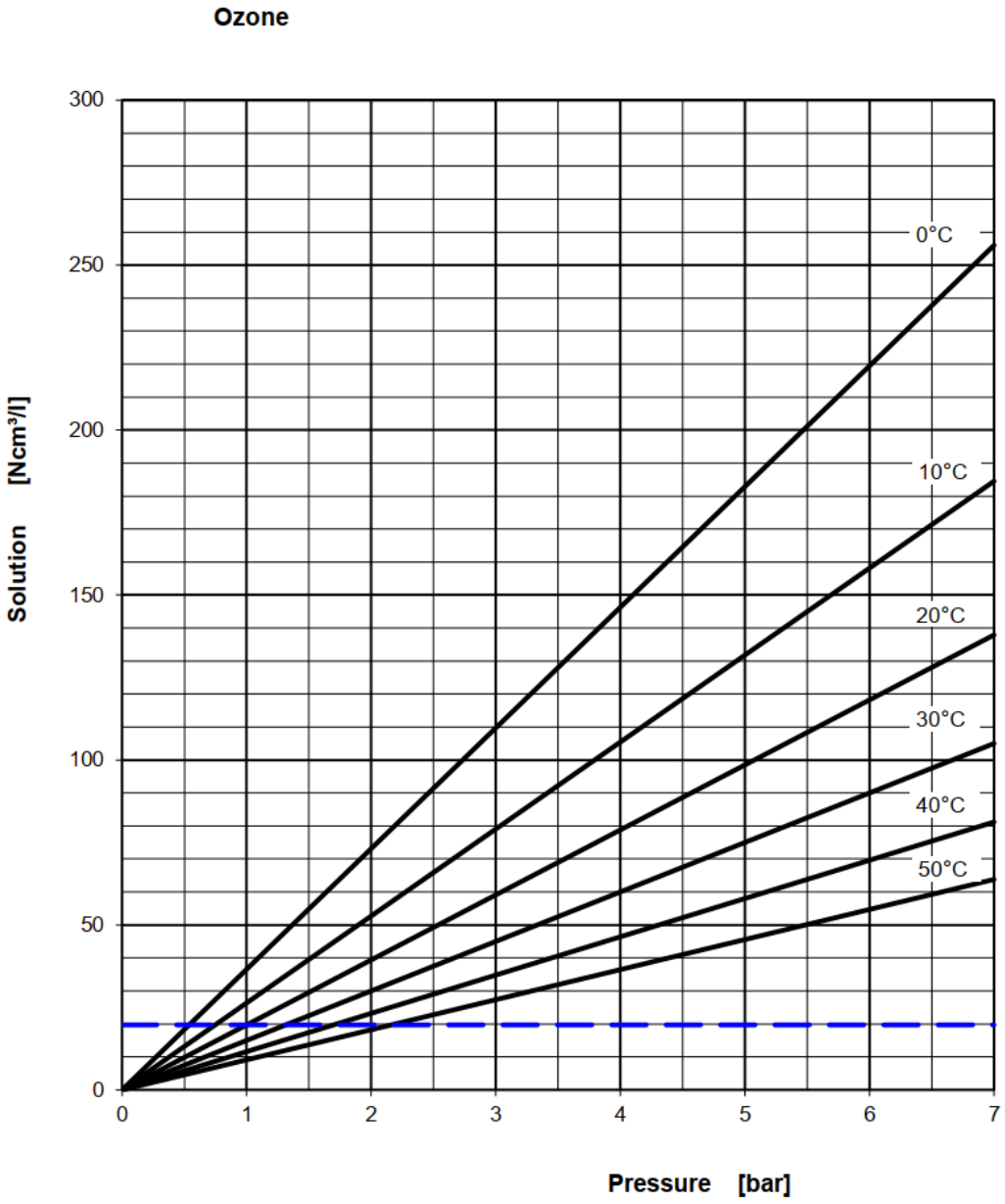


Remaining gas volume after dissolving to 1013 mbar at 20°C

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com



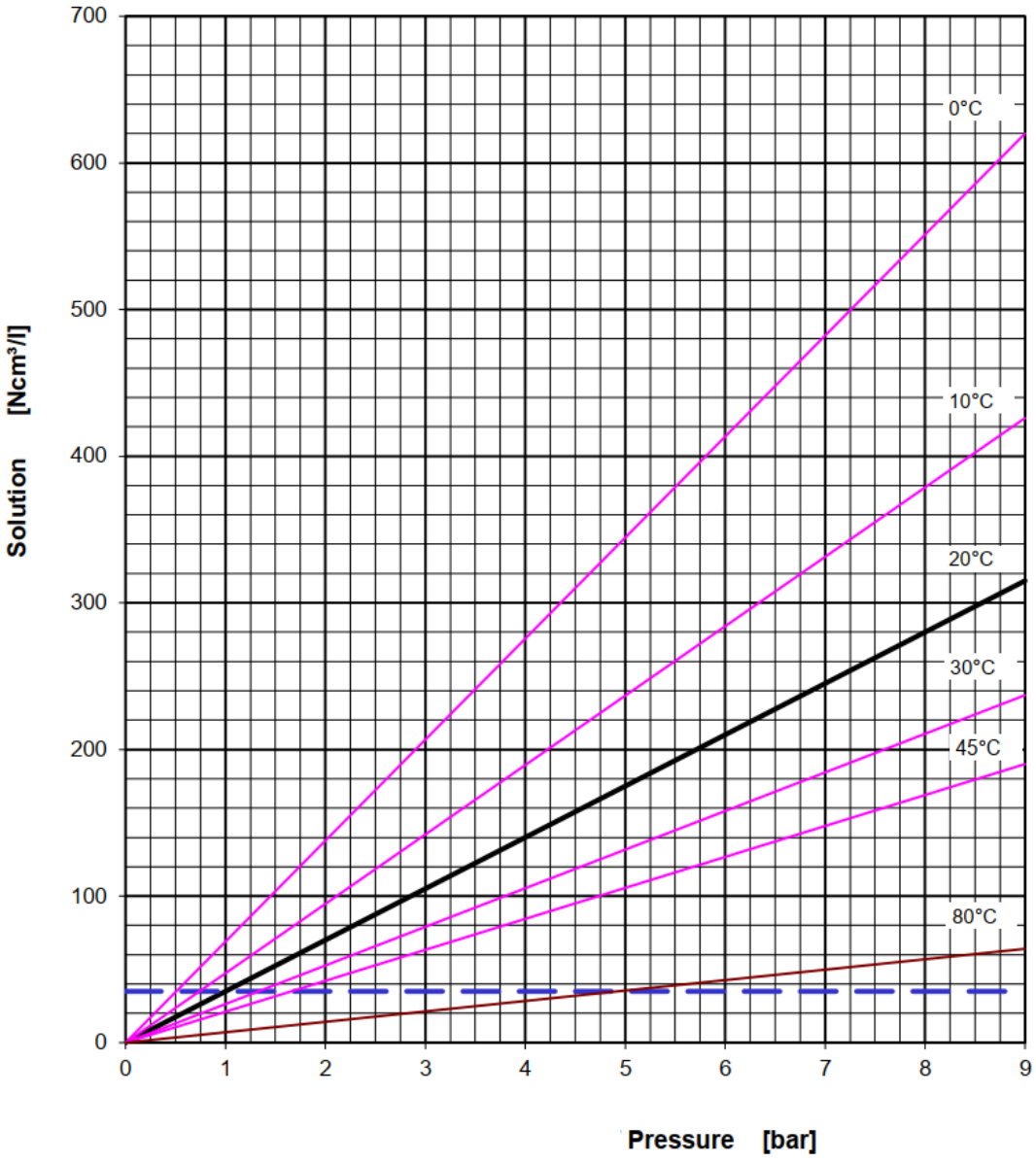
Remaining gas volume after dissolving to 1013 mbar at 20°C



Solubility ozone per 200g ozone / Nm^3 O_3 conc. inlet gas

Remaining gas volume after dissolving to 1013 mbar at 20°C

Methane



Remaining gas volume after dissolving to 1013 mbar at 20°C

Solubility of CO_2*0,04

EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG · Edisonstraße 33 · 24145 Kiel, Germany · +49 431 689868 · info@edur.de · www.edur.com