Lange Kleiweg 137
P.O. Box 83
2280 AB Rijswijk
The Netherlands

www.proqares.com

T +31 88 77 66 900
F +31 88 77 66 999
info@proqares.com

Avon Protection
Attn. Mr.J. Hine
Hampton Park west/Semington Road
Melksham, Wiltshire SN12 6NB
United Kingdom

Subject: H2S 10000 ppm
Your reference: POHC0100020522
Contact person: **M. de Jonge**

Ref.no.: 70399
Doc.no: 69538

Dear Mr. Hine,

At the request of Avon Protection (your reference POHC0100020522) performed adsorption capacity experiments with Hydrogen sulphide (H_2S) according to requirements stated by AVON. The experimental method and conditions are based upon EN14387 (2004) + A1 (2008). The details of the received samples are presented in Table 1, the experimental requirements are presented in Table 2; all test results are presented in Table 3. The detailed description of the adsorption test procedures is presented in the Annex. Note that the test results are only applicable to the tested materials, mentioned in Table 1. The samples arrived April 24th 2019, the experiments have been performed May 6th 2019.

Table 1: Received samples

Sample code ProQares	Description by customer
19 PQA 0868 – 1 / 6	NH15 Escape hood flat filter; NM40463 carbon; Shift 6-2

The samples are part of a twin filter configuration, therefor the flow through the filters is 15 L/min for the adsorption capacity experiments, recalculated for the twin filter configuration. It was agreed to continue until breakthrough.

Table 2: Experimental requirements

Agent	Influent concentration (ppm)	Breakthrough concentration (ppm)	T (°C)	RH (%)
Hydrogen Sulphide (H_2S)	10000	20 & 10	20	70

In Table 3 the results of the adsorption capacity experiments are presented.

Table 3: Test results class ABEK1

Sample code	Agent	Breakthrough time 10 ppm (min)	Breakthrough time 20 ppm (min)
19 PQA 0868 – 1	H_2S	87	89
19 PQA 0868 – 2	H_2S	89	91
19 PQA 0868 – 3	H_2S	91	93

We trust all things are clear to you. In case of any questions, please do not hesitate to contact us.

Kind regards,

M. de Jonge
Author

Mr. C. Jansen
Managing director

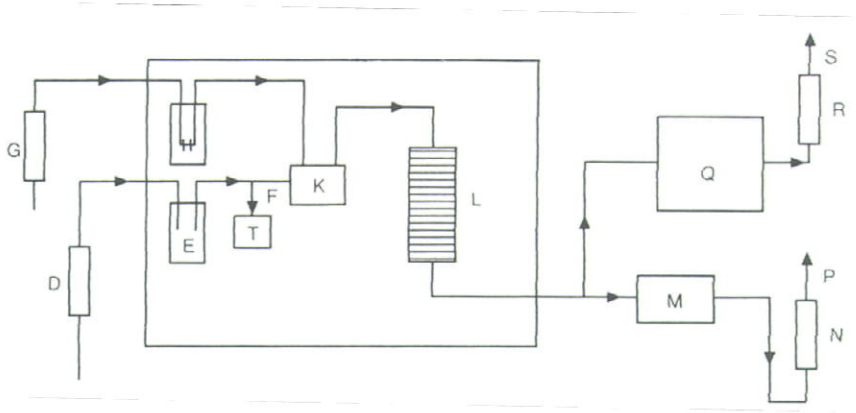
Direct dialling: **+31 88 7766933**
Direct fax: **+31 88 7766999**
Email: **menno.dejonge@proqares.com**

ANNEX 1 DESCRIPTION OF TEST METHODS

In this part the description of the test methods with various agents are described.

In Figure 1 the schematic set-up of the breakthrough apparatus is presented.

Figure 1: the schematic set-up of the breakthrough apparatus



D flow meter for air
E water saturator
F excess of air (not in use in case of sinusoidal flow)
G flow controller for vapour generating branch of airflow
H vapour generating system
K mixing chamber
L filter to be tested
M safety charcoal filter
N breathing machine
P vacuum system
Q analysis of effluent concentration
R flow controller for detection
S vacuum system
T measurement of T and RH

An excess of clean, dry air is led through a water saturator (E), which brings the air that will pass the carbon bed to the desired temperature and relative humidity; from there the air is led to the mixing chamber (K) where it is mixed with the generated component. The flow through the carbon bed is sucked by using a vacuum system. Temperature (T) and relative humidity (RH) of the air that passes the carbon are checked with a humidity and temperature gauge indicator and adjusted if necessary. The analysis system (Q) is connected to the apparatus just upstream of the safety charcoal filter.

The vapour of hydrogen cyanide, DMMP, cyclohexane, bromine, phosphor trichloride, chloropicrine, acrylonitrile, acroleine, mustardgas and sarin is generated by leading a known flow of air, controlled with controller (G), through a bubbler (H) that is kept at a constant temperature by using a cryostat. Knowing the vapour pressure of the

component at the set temperature and the airflow through the bubbler, the amount of generated vapour can be calculated. As the flow through the canister is known, the concentration could be calculated as well.

The vapour of formaldehyde is generated by evaporation of paraformaldehyde by heating. The influent concentration is measured with an acoustic infrared analyser, the effluent concentration is measured with an electrochemical sensor.

The vapour generation of chlorine, hydrogen sulfide, hydrogen chloride, nitrogen oxide, phosgene, ethylene oxide, sulphur dioxide, chloro cyanide, ammonia, isobutane and dimethylether are performed from a pressurised cylinder by using a calibrated mass flow controller. For phosphine and nitrogen dioxide calibration gasses are used to generate the required concentration.

Prior to the tests, the flow meters and the humidity and temperature gauge indicator are calibrated. The effluent concentrations of chlorine, hydrogen sulfide, hydrogen chloride, phosgene, nitrogen oxide, hydrogen fluoride, bromine, phosphor trichloride, ethylene oxide, sulphur dioxide and ammonia are measured with a calibrated electrochemical detector (Dräger polytron). The influent concentrations are not measured; they are calculated from the flow that is offered by the calibrated mass flow controller that is used for generation.

The influent concentration of cyclohexane, chloropicrin, hydrogen cyanide, DMMP, chloro cyanide, acrylonitrile, methyl iodide, mustard gas, sarin and acroleine is measured every 3 minutes using a gas chromatograph equipped with a FID detector. Sarin, mustard gas and DMMP effluent concentrations are measured with a MINICAM with the designated appropriate detector, the others are all measured using a gas chromatograph equipped with a FID detector.

For hydrogen cyanide and chloro cyanide the gas chromatographs are calibrated with pressurized cylinder containing a calibrated mixture of the hydrogen cyanide in nitrogen.

The breakthrough time of a filter or a carbon bed in case of an adsorption experiment depends on the following parameters:

1 the air flow through the filter
2 the influent concentration
3 the temperature
4 the relative humidity of the air
5 the effluent concentration

When all uncertainties of these parameters are taken into account, the accuracy of the breakthrough time is determined to be 10%.