



Application to vary a bespoke installation environmental permit

Supporting Information

December 2023

Issue Record

Client: Radnor Hills Mineral Water Company Ltd.

Project: Application to vary a bespoke installation permit - Supporting Documentation

Version: Issued

PREPARED BY

Dan Sandrof Consulting
Colburn,
Upton Bishop,
Herefordshire
HR9 7UE
Email d.sandrof@btinternet.com

Signature:

A handwritten signature in blue ink, appearing to read 'D. Sandrof', is positioned below the 'Signature:' label.

Name: Daniel Sandrof

Position: Environmental Consultant

Date: 1st December 2023

Contents

Introduction	4
Reason for the proposed changes	4
About the ferric chloride dosing system.....	4
Location.....	4
Environmental Management System	5
Environmental Risk Assessment	5
H1 screening assessment.....	6
Design measures and operator management control measures	6
Technical Standards	7
Raw Materials	7
Environmental monitoring and emission measurement point	7
OPRA	8

Figures

- Figure 1 Block Diagram to describe the addition of the ferric dosing unit to the bioreactor nutrient management system

Appendices

- Appendix A Regulatory Correspondence
- Appendix B H1 Screening Assessment for the ferric chloride dosing unit
- Appendix C Ferric chloride solution data sheet

Introduction

This document provides supporting information for an environmental permit application to vary a bespoke installation permit (ref. EPR/AB3697CN) operated by Radnor Hills Mineral Water Company Ltd. The purpose of the variation is to add a ferric chloride dosing unit at the Effluent Treatment Plant that will optimise the performance of the biological treatment process.

Reason for the proposed changes

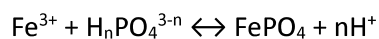
The Soluble Reactive Phosphorus as P emission limit value (ELV) assigned to the treated effluent emission point (W1) has been exceeded on several occasions. In consideration of this, and in agreement with Natural Resources Wales (NRW), Radnor Hills Mineral Water Company Ltd. (Radnor Hills) conducted a ferric chloride dosing trial during October 2023, which proved the method to be an effective way of reducing the level of P at the emission point.

Radnor Hills intend to make the dosing unit a permanent feature of the Effluent Treatment Plant. NRW have advised Radnor Hills that it would be necessary to apply to vary the Environmental Permit accordingly (see Appendix A – *Regulatory Correspondence*).

About the ferric chloride dosing system

Ferric chloride will be dosed directly into the Effluent Treatment Plant's bioreactor in conjunction with the two existing dosing units (phosphorus and nitrogen) to provide an enhanced nutrient balancing capability in the biological treatment process.

Ferric chloride will be dosed into the MBR bioreactor where the iron will bind with P to form a precipitate in accordance with the following basic reaction:



The precipitate will be removed from the effluent by the Ultra Filtration membranes and removed as sludge via the existing sludge disposal route.

Ferric chloride dosing is widely used across the municipal effluent treatment sector for P removal and is considered a safe, reliable and proven method. The use of ferric chloride to chemically precipitate P from wastewaters is recognised in the Best Available Techniques (BAT) Reference Document for the Food, Drink and Milk Industries¹ and specified as BAT (BAT 20) in the Best Available Techniques (BAT) Reference Document for Waste Treatment².

The dosing unit comprises the following components:

- Ferric chloride storage vessels e.g. 25lt drum or IBC, positioned on spill containment vessels
- High precision dosing pump and controller
- Feed line to bioreactor

Location

The ferric chloride dosing unit will be located within the Effluent Treatment Plant existing operational area, adjacent to the phosphate and nitrogen dosing units, to form part of the bioreactor's nutrient management system.

¹ Joint Research Centre (2019): Industrial Emissions Directive 2010/75/EU Best Available Techniques (BAT) Reference Document for the Food, Drink and Milk Industries

² Joint Research Centre (2018): Industrial Emissions Directive 2010/75/EU - Best Available Techniques (BAT) Reference Document for Waste Treatment

Environmental Management System

Radnor Hills operates an Environmental Management System (EMS) certified to ISO 14001:2015. The EMS provides the framework by which Radnor Hills manages the environmental impact of its site, operations and value chain where possible. It is an evolving system as aspects of site operations change.

The elements of the management system that have been created or changed to cover the proposed addition of the ferric chloride dosing unit includes:

- An Environmental Risk Assessment – see below.
- Design control measures – see below.
- Operator management and maintenance control measures – see below.

The operational method statements and operator risk assessment (RAMS) for all operational and maintenance tasks to be applied to the ferric chloride dosing unit shall be included in the following document library: *Wastewater Treatment and Recycling Plant - Operation and Maintenance Manual - Operating procedures.*

Environmental Risk Assessment

The operation of the ferric chloride dosing unit has the potential to impact the environment as follows:

- Point-source emissions of ferric chloride at the treated effluent emission point (W1)
- Fugitive emissions of ferric chloride

These potential hazard scenarios have been risk assessed as below.

Table 1. Summary of qualitative Environmental Risk Assessment for the operation of the ferric chloride dosing unit

Hazard	Scenario	Probability	Severity	Mitigation	Risk	Comment
Ferric chloride	Elevated concentrations of iron, chloride and lead entering controlled waters (the River Teme) via the emission point during normal conditions resulting in deterioration in water quality	Low	High	Design and operator management control measures	Low	A H1 assessment has been completed, which determined that the level of substances that could enter the River Teme are in such small quantities that they are unlikely to cause a significant impact on the receiving watercourse.
	Ferric chloride is accidentally overdosed resulting in iron, chloride and lead entering controlled waters (the River Teme) via the emission point resulting in deterioration in water quality	Low	High	As above	Low	

	Equipment failure resulting in spillage for ferric chloride	Low	High	As above	Low	
--	---	-----	------	----------	-----	--

H1 screening assessment

The potential impact of ferric chloride being discharged into the River Teme has been conducted using the H1 screening assessment method for all substances identified within the ferric chloride solution using the maximum dosing rate that could be applied. The assessment found that the release of substances would be in such small quantities that they unlikely to cause a significant impact on the receiving watercourse. Further details of the H1 assessment are provided in Appendix B.

Design measures and operator management control measures

The design and operator management control measures that have been identified through the environmental risk assessment have been incorporated in Radnor Hill's operational procedures (see Appendix B) and are summarised below:

Design Measures

- The dosing equipment shall be designed and installed in accordance with all appropriate standards.
- The equipment shall be constructed in a way that is sufficiently robust that it cannot be easily tampered with or used accidentally.
- Ferric chloride shall be maintained in proprietary containers and stored on drip containment system and located on impermeable surfaces within the containment system.
- All dosing pipework shall be dual contained.
- The dosing pump shall be sized to the smallest suitable to maximise dosing accuracy and reduce potential to exceed dose.
- Operator alarms for fault conditions in the dosing system shall include a stop-dosing fail-safe.

Management and maintenance measures

- Only low impurity dosing agents shall be used.
- Only Radnor Hills operators that have been trained in the proper use of the dosing equipment shall be permitted to operate the dosing unit.
- Radnor Hills operators will attend the dosing equipment twice daily as a minimum to perform operational checks on the dosing unit.
- Radnor Hills operators shall operate the dosing equipment in strict accordance with the written operational method statement and operator risk assessment (RAMS), unless under the direct guidance of Aqua Bio technical advisors. Should any changes to the operational methods applied be proposed where it could have the potential to increase risk to the environment and/or human health, Radnor Hills shall revise the applicable risk assessments accordingly. Where the revised risk assessment determines that the intended change may have an increased risk to the environment, sufficient measures shall be applied to reduce that risk. In such an event, changes may only be allowed where it has been agreed in writing by NRW.
- Dosing shall be applied at a fixed rate based on the previous performance trial and only adjusted by Radnor Hill's operators where deemed necessary to ensure the balance of nutrients within the bioreactor. The maximum dosing rate of 0.74 lt/hr shall not be exceeded.

- Samples of wastewater and treated effluent shall be analysed daily as part of the effluent treatment plant operational monitoring and management process. Split samples of treated effluent shall be sent to an independent UKAS accredited laboratory in accordance with the existing environmental permit monitoring requirements.
- Stock levels of ferric chloride will be monitored and recorded daily to ensure that over-dosing does not occur.

Technical Standards

The relevant technical guidance notes and Best Available Techniques applicable to the EPR Schedule 1 activity (*Treatment of process effluent*) include:

- *How to comply with your environmental permit* v8 Nov 2014
The technical standards defined in this guidance note are met at Radnor Hills through the written management system and the associated environmental risk assessment as defined within this application, which hereon will form part of Radnor Hills' management system.
- *M18 Monitoring of discharges to water and sewer* v5 Oct 2014
The technical standards set out in this guidance (where applicable) are met at Radnor Hills through the written management system.
The specific elements of the management system pertaining to the monitoring of the treated effluent are described in the operational emissions monitoring procedure. No changes to the periodic monitoring of treated effluent at emission monitoring point W1 are proposed as part of this variation application.
The monitoring and management of nutrient balance within the effluent treatment plant is documented within the effluent treatment plant operating manuals, which also form part of the Radnor Hills written management system.

A block diagram of the effluent treatment plant process flow is provided in Figure 1 to illustrate the addition of the ferric dosing unit to the bioreactor nutrient management system.

Raw Materials

The raw materials used in the ferric chloride dosing unit includes ferric chloride solution (14% ferric). The material data sheet for the solution to be used is provided in Appendix C.

The ferric chloride solution is currently stored in 25lt drums; however, Radnor Hills may increase the storage capacity to 1m³ IBCs, in accordance with the existing phosphate and nitrogen dosing units. In any event, the maximum storage capacity at any one time would be no greater than 2 tonnes (~1 m³). Based on the current estimated dosing rate of 5.7lt per day, the annual quantity of ferric chloride solution estimated to be used would be no greater than 2,000 litres per annum (~4 tonnes per annum).

Environmental monitoring and emission measurement point

The measures used to monitor emissions of treated process effluent to surface water includes routine spot sampling from the effluent monitoring point W1 and sending the samples collected for analysis at a UKAS accredited laboratory. This activity is conducted in accordance with a written procedure that forms part of Radnor Hills' management system. No changes are proposed as part of this variation application to the monitoring location or testing methodology.



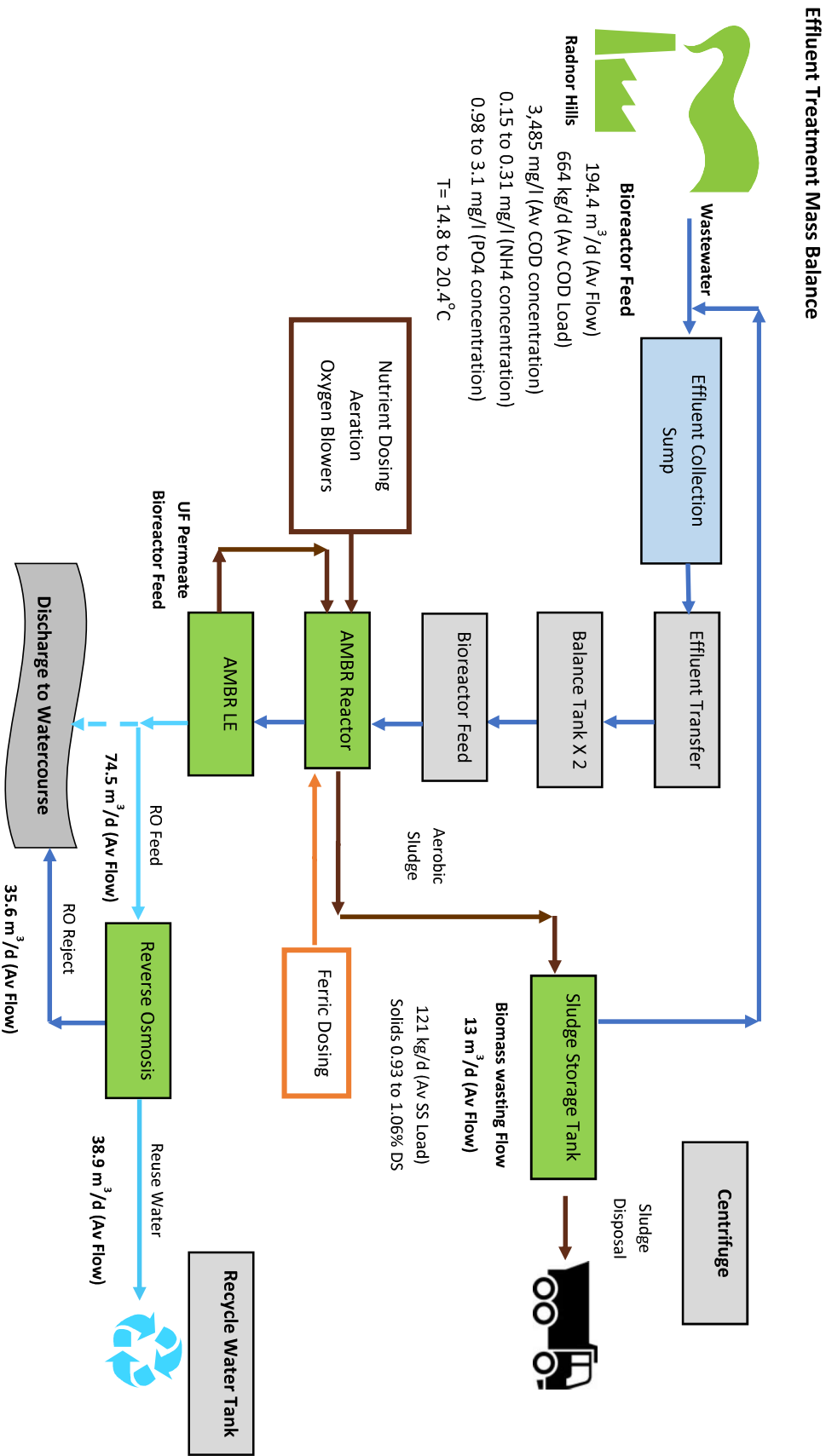
OPRA

In accordance with Question 2 of Form F1, the most recent OPRA spreadsheet is provided as part of this application in electronic format.



Figures

Figure 1. Block Diagram to describe the addition of the ferric dosing unit to the bioreactor nutrient management system (from EMS 007 – Emission monitoring procedure)





Appendix



Appendix A Regulatory Correspondence

d.sandrof@btinternet.com

From: Griffin, Victoria <victoria.griffin@cyfoethnaturiolcymru.gov.uk>
Sent: 13 November 2023 12:11
To: Ben Price
Cc: Rob Isaac
Subject: RE: Notification of Ferric Dosing Trial and ISO 14001
Attachments: image010.png; image013.png; image019.png; image021.jpg; image023.jpg

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good afternoon Ben

Thank you for providing a summary of the ferric dosing trial undertaken between 19 September and 3 October 2023.

The information provided shows that the trial did not result in any permit breaches. The next step, should you wish to proceed with Ferric Dosing as part of the effluent treatment process, would be to apply for a permit variation. It is important that you are satisfied with trial methodology /procedures and it was representative of general production patterns, as any non-compliance will be scored.

Please note that ferric dosing must not continue until the variation application has been determined.

Kind regards

Victoria Griffin BSc (Hons) MSc CEnv
Uwchswyddog Rheoliad Diwyddiant / Senior Officer Industry Regulation
Tîm Rheoliad Diwyddiant Gogledd Ddwyrain / Industry Regulation
0300 653 389 / 07815 977620
MIEnvSc



Appendix B H1 Screening Assessment for the ferric chloride dosing unit



Radnor Hills

Surface Water Discharge: H1 assessment of proposed ferrous chloride dosing trial

24th July 2023

Introduction

Treated permeate and RO reject water from Radnor Hills Mineral Water Company Ltd. (Radnor Hills) is discharged to the River Teme as a surface water discharge. The discharge has on occasion exceeded the Soluble Reactive Phosphorus (SRP) emission limit value (ELV) specified in the Environmental Permit. Radnor Hills has been working with effluent treatment technical support specialists AquaBio Ltd., on how the treatment plant could be managed and modified to reduce phosphorus emissions to below the ELV. Ferrous chloride dosing is a technique that is utilised widely in the drinking water treatment industry for its various beneficial properties; and Aquabio have designed a trial ferrous chloride dosing system to determine whether the technique would be successful in reducing phosphorus at Radnor Hills.

Natural Resources Wales (NRW) have been consulted on the proposed trial and have agreed to the trial in principle subject to a number of precautionary criteria being met. One of those criteria is for Radnor Hills to provide:

- *'An updated H1 assessment which considers all potential chemical releases from the proposed dosing'*

Approach

The methodology was undertaken in line with Environment Agency Horizontal Guidance document H1 Annex D - Basic surface water discharges.

The H1 software tool has been used for this assessment. Input data used in the assessment are as follows.

Input data and justification

Identification of relevant impacts: The activity has the potential to impact releases to water, therefore the H1 tool been used for the environmental assessment of releases to water only.

Freshwater Q95 flow rate (m³/s): The river flow data used has been previously calculated by Rukhydro and was used in the H1 assessment that supported the original environmental permit application for the Installation in 2016. The submission stated the following:

There are no nearby continuous flow data for the Teme (nearest gauge is at Tenbury) and so Rukhydro derived these flow statistics using available spot flows for the Teme near Heartsease correlated to gauged flows on other nearby rivers or river stage measurements at Knighton. The derivation of the data is described in the Rukhydro draft Groundwater Addendums.



- 95 percentile (stage at Knighton = 0.535 m): 0.09 m³/s (7,776 m³/day)

Mean effluent flow rate (m³/s): The effluent flow rate is measured by a flow meter and recorded daily in m³ per hour by Radnor Hills' data acquisition software. Mean flow rates have been calculated based on the daily readings recorded by Radnor Hills between Jan 2022 and February 2023.

Maximum effluent flow rate (m³/s): The maximum effluent flow rate is specified in the Environmental Permit as 194.4 m³/day. This figure has been converted to m³/sec to provide the maximum flow rate.

Substances assessed: The ferrous chloride dosing solution contains iron and chloride as its principal components. The product that will be used is a 40% solution. The product data sheet identifies a number of impurities in the product, which are all metals. All the identified metals stated as all having concentrations below the analytical limit of detection, except for lead which is stated to have a typical concentration of 5 ppm.

The substances assessed in this H1 assessment are iron (dissolved), chloride and lead (and its compounds).

Measurement method: The substances are expected to be quantified from spot samples during the trial, but for this H1 assessment the measurement method is based on estimates.

Operating mode: While the trial is by its nature temporary, the operating mode applied in the H1 assessment has been set at 100% i.e. continuous full time, to be conservative and on the basis that the trial can be assumed to continue full-time if the trial period is found to be successful in achieving its objectives.

Average/maximum concentrations: Aquabio have conservatively estimated the concentration of iron, chloride and lead in the discharge water. Their estimate is based the maximum dosing rate that would be applied in practice and maximum carryover that could occur through the treatment system. The maximum concentrations of the substances already present in the effluent as measured by test data have been added to those concentrations as summarised in the table below.

Substance	Conservative assessment of concentration in discharge water for dosing (mg/l)	Average concentration in the untreated effluent ¹ (mg/l)	Max concentration in the untreated effluent ¹ (mg/l)	Concentration in the discharge water applied in H1 assessment (mg/l)
Iron	1.12	0.48	0.663	1.8
Chloride	37	66.05	85.9	122.9
Lead and its compounds	0.00164	0.000219	0.000274	0.001914

¹ Laboratory test certificate for samples obtained on 20/05/2020, 20/09/2020, 22/11/2020 and 02/04/2022.

Findings

The H1 assessment for the substances failed screening Test 1 (<10% of the EQS) but passed Test 2 (PC <4% of the AA-EQS and the MAC-EQS (for lead and its compounds)). On this basis, the release of substances is assessed as being in such small quantities that they unlikely to cause a significant impact on the receiving water.

The output from the H1 software tool is shown below. A copy of the H1 tool is provided in .exe format for reference.

H1 software tool output table for releases to water

Freshwater								
Option	Type of water body	Release point code	Substance	Freshwater test 1	Freshwater test 2	Freshwater test 3	Freshwater test 4a	Freshwater test 4b
1 R	W1		Iron (dissolved)	Fail	Pass			
1 R	W1		Chloride	Fail	Pass			
1 R	W1		Lead and its compounds	Fail	Pass			



Appendix C Ferric chloride solution data sheet



P.O. Box 600
San Felipe, TX 77473
Customer Service 800-864-1742
FAX 888-273-6226

Product Data Sheet Ferric Chloride Solution

Revision Date: 4/4/14

Description

Pencco's Ferric Chloride is a dark maroon aqueous solution of soluble ferric iron, manufactured to strict specifications from high quality raw materials. Pencco's unique manufacturing process renders a superior Ferric Chloride that is stable at concentrations up to 14% ferric iron. Pencco's Ferric Chloride has a low ferrous iron content, reducing the likelihood of iron carryover throughout the system.

*A Ferric Chloride product with low manganese content (<50 ppm) is available upon request.

Application

Ferric Chloride is manufactured for both municipal and industrial water treatment. Being an iron-based coagulant and having only trace amounts of aluminum, it is widely used for the clarification of drinking water. Ferric Chloride is very effective as a coagulant in oily water clarification. It is excellent for turbidity control, as well as the removal of phosphorus, color, TOC's and suspended solids. Ferric Chloride is widely used for sludge dewatering, as well, resulting in volume reduction. It is very effective at removing arsenic and selenium.

Typical Analysis

Concentration (%Fe ⁺³).....	10 – 14%
Concentration (%Fe ⁺²).....	<0.5%
Specific Gravity.....	1.35 – 1.6
Free Acid.....	<0.5%
pH.....	<2.0
Appearance.....	Dark Maroon
Freezing Point.....	<0°F

Health and Safety

Ferric Chloride can cause irritation and burns to the skin and eyes. Ensure that individuals handling Ferric Chloride have been fully trained regarding the MSDS, along with PPE requirements and specific operational procedures. In the event of an emergency, call 24 hr. CHEMTREC: 800-424-9300.

Certifications

Ferric Chloride is ANSI/NSF Standard 60 certified for use in potable water treatment and also meets or exceeds all AWWA standards.

Product Handling and Shipping

Ferric Chloride is shipped in railcars, tank trucks, totes, and drums. Suitable materials of construction include fiberglass, PVC, polypropylene, polyethylene, and stainless steel. It can be used with diaphragm metering pumps, providing the materials of construction are compatible. No dilution or preparation necessary.

DOT Classification: Ferric Chloride Solution

Hazard Class: 8

DOT ID Number: UN 2582

Packing Group: III

RQ = 1000 Lbs.

Pencco provides the information contained in each material safety data sheet ("MSDS"), technical data sheet ("TDS"), product information brochure and/or information contained herein (including data and statements) in good faith and makes no representations as to its comprehensiveness or accuracy as of the date of publication. The MSDSs, TDSs, and product information brochures are referred to collectively as the "Data Sheets". It is the responsibility of the user to obtain and use the most recent version of the Data Sheets. Each Data Sheet relates only to the specific product designated therein and may not be valid where such product is used in combination with any other materials or in any process. Further, since the conditions and methods of use of the product and information are beyond the control of Pencco, Pencco expressly disclaims any and all liability as to any consequential damages or results obtained or arising from any use of the products or the information contained in the Data Sheets. NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE AS CONCERNS THE DATA SHEETS OR THE RELATED PRODUCTS.