

Compliance Assessment Report CAR_NRW0040776

Permit being assessed: BR9685IX.

For: Barry Silicone Plant, held by Dow Silicones UK Limited

At: Cardiff Road, Barry, Vale of Glamorgan, CF63 2YL.

Type of assessment carried out: Site Inspection, Reason: Routine.

On 20/10/2022 between 10:00 and 11:00.

Parts of permit assessed: Schedule 3

NRW Lead Officer: Geraint Harris, accompanied by Antony Leakey.

Report sent to: Jude Sartor, Environmental Specialist on 06/12/2022.

1. Summary of our findings (full details in section 4)

Part of permitted activity assessed (criteria)	Assessment result	Permit condition
C2 - General Management - Management system and operating procedures	Action only (X)	
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C2 - General Management - Management system and operating procedures	Action only (X)	
C2 - General Management - Management system and operating procedures	Action only (X)	
E1 - Emissions - Air	C3 Minor (Suspended)	permit condition 3.1.2.

Result types are explained in more detail in the 'Important Information' section below.

Total number of non-compliances recorded	Total non-compliance score
1	0

How we use the non-compliance score to calculate your annual fee is explained in the 'Important Information' section below.

2. What action is required?

Criteria	Action needed	Complete by
C2	Action 1: Are the readings prior to the DP rise true? If so, have you done an investigation into what may have caused the sudden sharp rise?	16/01/2023
C2	Action2: having established that there was a problem with DP, did you arrange to have a look inside the column to investigate the cause and consequence?	16/01/2023
C2	Action 3: Since the demister pad is part of the abatement	16/01/2023

Criteria	Action needed	Complete by
	infrastructure. Did Dow not anticipate that a failed demister would cause emissions problems?	
C2	Action 4: Given the importance of the demister pad and the 8-9 months long lead time for a replacement, what measures were put in place to try and limit the impact this may cause on ERU emissions?	16/01/2023
C2	Action 5: Please provide all the operating procedures related to the demister pad and differential pressure system that were used around December 2021. I would like to know what the triggers for the dp alarm were and what the actions were following a spike?	16/01/2023
E1	Undertake the improvements mention within this Car Form	31/03/2023

Action criteria codes are listed in the 'Important information' section below.

3. What will happen next?

Any non-compliance we have identified and recorded on this form is an offence. It can result in criminal prosecution and/or suspension or revocation of your permit.

At this time, we do not intend to take any further action.

This statement does not stop us from taking additional enforcement action if further relevant information comes to light or offences continue.

4. Details of our assessment

Dow ERU Particulate Matter Issues

FBR Analyser

The analyser used at the backend of the FBR was installed approximately 20 years ago. "The analyser was designed to track components contributing to heat load going to the ERU for control purposes and not particulates contributing components related to compliance". This analyser was not detecting SiH₄ during the time when a third-party testing facility was undertaking analysis of the particulate matter from the ERU. The analyser started working again following cleaning. "Assessment of the FBR final vent analyser, has shown that it is at the limit of detection, for components like SiH₄, so data it generates can be used to help guide decision making but are not 100% accurate. The new analyser, to be installed in 2023, will have much improved levels of detection, likely down to 10's of ppm. This system is being scoped and will enter design soon". Dow intend to develop a KPT related to the new analyser so that operators can react when results indicate the system is drifting out of compliance.

Scrubbers and demisters

During the extended shutdown period the ERU had a full inspection and clean of all equipment, including the stack and associated scrubbers and demisters systems. The presentation by Dow on the 20th of October highlighted heavy fouling within the stack and scrubbing systems and demister pad. Furthermore, the demister pad appeared to have been dislodged (due to a fastener coming loose). The movement of the demister pad could have led to increased particulate matter exiting the stack as well as enabling liquid re-entrainment within the gas flow. Such entrained liquid can be mistaken as particulate matter by some monitoring instruments. This may have contributed to the elevated particulate matter readings measured earlier this year. There is a differential Pressure (dp) measurement with a high alarm that allows Dow to monitor the pressure difference across the demister pad. When properly designed demister pads can give efficiency up to 99.9% with minimal pressure drop. This pressure drop should provide an indication on the

physical condition of the mist eliminator. Dow was asked, on the 18th of November, to examine the differential pressure across the demister pad, for the past 18-24 months, to ascertain if there had been any significant changes. Dow responded with a screen shot of the differential pressure display which showed a significant rise in differential pressure on the 12/12/2021. In their Schedule 5 notice sent on the 3rd of March 2022 Dow state "Issues with ERU dioxin stack sampling, due to solids blocking the sample probe, at the end of 2021 and start of 2022, led to a non-routine, additional particulates test being undertaken, by the external testing company, on request by Dow. The previous routine particulates sample (6/10/21) had passed, with a result of 2.3mg/m³ vs permit limit of 10mg/m³". Therefore, it appears that the event which has been causing high particulate matter emissions from the ERU is likely to have occurred around the 12th of December 2021. Increased pressure drops are usually a result of the build-up of material on the mist eliminator surface which results in the narrowing of the openings for the gas to flow through. This results in higher gas velocity through the demister pads which can drag the material and liquid through into the outlet gas stream. It is likely that a portion of the measured particulate matter may be attributed to liquid re-entrainment within the gas flow. This might explain why the operator was unable to observe any signs of particulate matter within the stack emissions during the period when emissions were as high as 570mg/l. As mentioned earlier, heavy fouling within the stack and scrubbing systems and demister pad within the ERU was observed during the maintenance period. Due to the extent of this fouling, the elevated particulate matter emissions measured throughout 2022 could be attributed to disturbance of this 'fouled' solid material within the ERU, however, this is no way of knowing if this is the case.

Please provide some clarity around the observation of the high differential pressure readings on the 12th of December 2021. I need to get an understanding of the decision making around this observation and understand if there has been a management oversight and to see if procedures need improvement.

Action 1: Are the readings prior to the DP rise true? If so, have you done an investigation into what may have caused the sudden sharp rise? **Due January 16th 2023.**

Action2: having established that there was a problem with DP, did you arrange to have a look inside the column to investigate the cause and consequence? **Due January 16th 2023.**

Action 3: Since the demister pad is part of the abatement infrastructure. Did Dow not anticipate that a failed demister would cause emissions problems? **Due January 16th 2023.**

Action 4: Given the importance of the demister pad and the 8-9 months long lead time for a replacement, what measures were put in place to try and limit the impact this may cause on ERU emissions? **Due January 16th 2023.**

Action 5: Please provide all the operating procedures related to the demister pad and differential pressure system that were used around December 2021. I would like to know what the triggers for the dp alarm were and what the actions were following a spike? **Due January 16th 2023.**

Dow were asked when was the last time the scrubber, packing material, bubble trays and demister pads were inspected? And is there a ppm arrangement for these bits of plant? They responded by stating that the scrubber system is inspected internally every 2 years. Dow's internal inspection involves removing the packing, this is also replaced during each internal inspection. The last Internal inspection carried out 16/08/2022. Packing was replaced with new as part of this internal inspection. According to Dow's inspection certificate no apparent issues were observed with bubble trays. As part of the preparation for internal

inspection the scrubber is washed with demineralised water until neutral pH is established. In addition to silica build up the pad and scrubbers also showed signs of caustic solids build-up. The build-up of caustic on the de-mister pad will most certainly affect its performance and ability for gas to pass through it. Dow was asked if the flow rate of the Caustic into the scrubber unit is measured, since fluctuations in flow rate can cause issues with the scrubbing efficiency due to fouling. Dow responded saying “there is no flow rate measurement on the Caustic dosing pumps, only pH/pump speed. Generally speaking, no major changes, pH remains very stable around ~ 7.6”. A graphic display of the pH was provided showing a steady pH reading for the caustic dosing pumps. Furthermore, no plugging on the liquid spray nozzles was observed. Going forward Dow intend to develop a KPT for ERU vent cleaning.

Chlorosilane Recovery Unit CRU

The Energy Recovery Unit (ERU) consumes waste gas from the direct process before venting. The ERU was not designed to incinerate silanes (SiH), only designed for non-fouling vents containing compounds: methyl chloride, methane, methanol, hydrogen and light hydrocarbons. However, there might be some particulate removal capability. Waste gas containing SiH species produce SiOx during thermal combustion which deposits and increases fouling of ERU. Such deposits were witnessed in the scrubbers, vents stacks and sample portal recently. The CRU catalysis SiH to chlorosilane (SiCl) species that can be condensed out before entering the ERU. The CRU is designed to reduce SiH load to the ERU but the conversion of SiH is not consistent and the importance of its potential role in compliance was not realised previously due to consistent emissions compliance.

Dow’s recent review of data supports the theory that optimum process conditions within the CRU are reached after CRU catalyst bed is refreshed, which minimises SiH₄ and so silica in the ERU. Dow’s bed change out frequency/maintenance plan will be reviewed after they have completed a CRU investigation (new PPM for catalyst change out on a yearly basis). The latest CRU catalyst change out was in April 2022, However, in May this catalyst experienced an exotherm which resulted in a systems shutdown. The cause and likelihood of these exotherms occurring is still unknown. There is a tendency for exotherms to be experienced when the catalyst bed is newer, but not exclusively so. During the site visit, Dow explained that the CRU process chemistry is not well understood, which has made identification of the root cause of exothermic incidents difficult. Dow have ongoing work to try to understand the fundamental chemistry of the CRU. They plan on chartering an R&D project to explore the CRU reaction chemistry at lab scale in Midland, USA with resources likely to be available to start baseline experimentation in Q4 2022. Dow are also planning on developing a sampling and analysing strategy for both the CRU inlet and outlet streams to get a better understanding of the CRU reaction chemistry. Dow hope to develop an additional layer of protection following completion of their intended R&D projects. Currently there is only one automated shut down system that usually results in the reactor exceeding its maximum working temperature even after the feeds are tripped. Dow are looking into ways of spotting exotherms early to try to reduce the chance of exceeding the high-high temperature alarms and improve the relevant SOP’s for operators. All other controls are procedural, but Dow have already improved these and delivered training. The provision of additional layers of automated protection is a COMAH matter which is addressed via a different regulatory regime.

Dow are unclear if the heavy fouling seen within the scrubbing and vent systems is the cause of the elevated particulate matter releases from the ERU or are a symptom of an increase in SiH₄ containing vents from the CRU to the ERU. Their ongoing and planned research aims to shed some light on the root causes. Dow are planning on restarting the CRU soon. All of the scrubbing systems and vents have been maintained and

cleaned during the recent site shutdown period. Dow have organized third party particulate matter (pm) testing on the 31st Oct, 4th Nov and 8th December. This should help identify if the scrubbing system was a significant factor in the PM ELV exceedances seen in 2022. Since the analysis of PM is undertaken by a third-party testing house, results may take up to 6 weeks to be received.

Non-Compliance Scoring

Due to different permits having different reporting periods, NRW have consolidation rules which allow each operator to be treated consistently. Using these rules, we will enter one non-compliance for each emission limit value that is breached during a quarter, regardless of reporting period. If data is submitted at six monthly or annual intervals, we should assess it as if it was submitted quarterly. We consolidate scores for each quarter, so there could be two non-compliances for six monthly data, and four for annual data. Where a non-compliance with a permit/licence condition has previously been identified, and a permit holder is actively trying to address the issue, it may be appropriate to suspend subsequent scores. Suspended scores do not count towards calculating the compliance band or subsistence charges for a site. Each non-compliance must still be recorded on CARS with an explanation of why the score is suspended. We may also suspend scores if the permit holder has agreed a voluntary improvement plan with us. The plan must set out the actions needed to remedy the non-compliance(s) and the timeframe in which they will be completed. If the permit holder does not complete the plan, then we will immediately reinstate any suspended scores. We only suspend scores for a maximum of six months under a voluntary improvement plan. Unless there is a statutory notice in place, the suspension of scores is at our own discretion. It is not a right and we are not obliged to suspend scores.

The initial non-compliance occurred in February (Q1). Since there is a plan in place to bring the site back into compliance and analysis has demonstrated that the air quality standard has not been breached, I can suspend any additional scores for a maximum of 6 months (end of Q3). Therefore, as it stands there are no additional non-compliance scores related to this incident. However, any exceedances going forward will need to be reviewed and additional scores applied. For example, if the testing undertaken on the 31st Oct, 4th Nov and 8th December all exceeded the permit ELV a consolidated score of 1 x CAT 3 would have to be applied due to this being outside the 6 month window.

Q3 Monitoring Returns

Q2 monitoring returns were received on the 28th of October 2022. These are required by reporting condition 4.2.3. The results have been accepted.

END.

If you have any queries about this report, or to discuss completion of any actions, please contact the NRW Officer named above.

Important information

Legal status of this report

Your permit is issued to you under the Environmental Permitting Regulations. You have a responsibility to comply with the conditions of your permit and prevent pollution/harm of the environment. You must also ensure that you comply with any other relevant legislation that may apply to your site's operations.

This report explains the findings of our assessment and any action you are required to take. We categorise non-compliance using our guidance for assessing non-compliance at regulated sites.

When we find potential non-compliance/s we will normally give you advice on how to maintain compliance.

To correct non-compliance, we may:

- require you to take specific actions
- issue a notice
- review the conditions of your permit.

Any advice and guidance we give will be without prejudice to any other enforcement response that we consider may be required.

Assessment results and non-compliance categories (used in section 1):

Assessment result	Description
Assessed (A)	Assessed or assessed in part, no evidence of non-compliance found
Action only (X)	Action only relating to the activity assessment
Ongoing (O)	Ongoing non-compliance, not scored

Non-compliance category	Description	Score
C1 Major	Potential to have a major, serious, persistent and/or extensive impact or effect on the environment, people and/or property	60
C2 Significant	Potential to have a significant impact or effect on the environment, people and/or property	31
C3 Minor	Potential to have a minor or minimal impact or effect on the environment, people and/or property	4
C4 No environmental impact	Non-compliance at a regulated site that cannot foreseeably have any impact on the environment, people and/or property	0.1

How we use assessment scores

The number and severity of non-compliances recorded in a year will affect your annual subsistence fee the following year. A non-compliance factor is added to your site's Operator

Performance Risk Appraisal (OPRA) score when we calculate your fee to reflect the additional resource we use to assess permit compliance.

What are suspended scores?

In line with our guidance, we may suspend scores for up to six months to allow time for remedial action to be taken. Suspended scores will be re-instated if the action is not completed.

Full list of Industry and Waste action criteria (used in section 1 and 2):

A: Permitted activities

- A1 Specified by permit

B: Infrastructure

- B1 Infrastructure – Engineering for prevention and control of emissions
- B2 Infrastructure – Closure and decommissioning
- B3 Infrastructure – Site drainage engineering (clean and foul)
- B4 Infrastructure – Containment of stored materials
- B5 Infrastructure – Plant and equipment

C: General management

- C1 General management – Staff competency/training
- C2 General management – Management system and operating procedures
- C3 General management – Materials acceptance
- C4 General management – Storage, handling, labelling and segregation

D: Incident management

- D1 Incident management – Site security
- D2 Incident management – Accidents, emergency and incident planning

E: Emissions

- E1 Emissions – Air
- E2 Emissions – Land and groundwater
- E3 Emissions – Surface water
- E4 Emissions – Sewer
- E5 Emissions – Waste

F: Amenity

- F1 Amenity – Odour
- F2 Amenity – Noise
- F3 Amenity – Dust/fibres/particulates and litter
- F4 Amenity – Pests/birds and scavengers
- F5 Amenity – Deposits on road

G: Monitoring and records, maintenance and reporting

- G1 Monitoring and records, maintenance and reporting – Monitoring of emissions and environment
- G2 Monitoring and records, maintenance and reporting – Records of activity, site diary/journal/events
- G3 Monitoring and records, maintenance and reporting – Maintenance records
- G4 Monitoring and records, maintenance and reporting – Reporting and notification to Natural Resources Wales

H: Resources efficiency

- H1 Resource efficiency – Efficient use of raw materials
- H2 Resource efficiency – Energy efficiency

Enforcement response

Any permit condition non-compliance is an offence and we may take legal action against you. Action we take can include prosecution, serving a notice on you and/or suspension or revocation of your permit. See our Enforcement and Sanctions Guidance for further information.

Data protection notice

You should make sure that anyone named in this report knows that the information it contains will be processed by Natural Resources Wales to fulfil its regulatory and monitoring functions and to maintain the relevant public register(s).

We may also use and/or disclose the report in connection with:

- offering or providing you with our literature or services relating to environmental matters
- consulting with the public, public bodies and other organisations (e.g. Health and Safety Executive, local authorities) on environmental issues
- carrying out statistical analysis, research and development on environmental issues
- providing public register information to enquirers
- investigating possible breaches of environmental law
- assessing customer service satisfaction and improving our service
- Freedom of Information Act or Environmental Information Regulations requests.

We may also pass it on to our agents or representatives to do these things on our behalf.

Disclosure of information – this report will be available to view on-line

If you think this report contains commercially confidential information that should not be placed on our public register, you must contact your local Natural Resources Wales office within **fifteen working days** of receiving this report, using the contact details in the accompanying email or letter. You must give a full explanation of why it should not be added to our public register, including specifying which information is commercially confidential. We will assess your request and respond to you within 20 working days to let you know if we agree to your request.

What do I do if I disagree with the report or have a complaint?

If you disagree with this compliance assessment report, you should contact the lead officer without delay to discuss your concerns.

If you are unable to resolve the issue with the lead officer or their line manager you should contact our Customer Contact team on 0300 065 3000 (Monday to Friday 08:00 – 18:00), or email enquiries@naturalresourceswales.gov.uk for details of how to raise your dispute further through our Complaints and Commendations procedure.

If you are dissatisfied with our response, you can contact the Public Services Ombudsman for Wales by phone on 0300 7900203 or by email at ask@ombudsman.wales

Welsh Language Standards

We are committed to establishing Natural Resources Wales as a naturally bilingual organisation. We will provide compliance reports in your preferred language.