

Compliance Assessment Report CAR_NRW0040390

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 11/08/2022 between 09:00 and 16:00.

Parts of permit assessed: Air Emissions

NRW Lead Officer: Geraint Harris.

Report sent to: Christopher Chadwick, Environment Manager on 26/09/2022.

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

Part of permitted activity assessed (criteria)	Assessment result	Permit condition
E1 - Emissions - Air	C3 Minor	permit condition 3.1.2.
C2 - General Management - Management system and operating procedures	C3 Minor	permit condition 1.1.1
E1 - Emissions - Air	C3 Minor	permit condition 3.1.2
C2 - General Management - Management system and operating procedures	C3 Minor	permit condition 1.1.1

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

Total number of non-compliances recorded	Total non-compliance score
4	16

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
E1	Improve operations to prevent further PM exceedances	Already completed
C2	Improve management systems so that effective control of particulate matter from the ERU is understood and implemented.	31/03/2023
E1	Improve operations to prevent the incidence from reoccurring.	Already completed
C2	Improve management system so that critical spares are available onsite.	Already completed

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 Silicones UK Ltd reporting and compliance assessment review

EPR-BR9685IX

Energy Recovery Unit (ERU) High particulates

NRW received a Schedule 5 Notice on the 3rd of March 2022 from Dow, stating that the particulate matter (PM) monitoring of the ERU emissions stack (A41) had exceeded the Emission limit Value (ELV) on the 11th of February 2022. Dow state that issues with solids blocking the sample probe were witnessed in late December and early January which resulted in Dow undertaking additional non-routine monitoring of the ERU in February. The monitoring was undertaken by a third-party testing company as usual. Due to the nature of the third-party testing, there is always lag between sampling and the receiving of results.

The permitted ELV for particulate matter out of emission stack A41 is 10mg/m³. The results of the monitoring on the 11th of February were as follows:

- Test 1 at 11:33 573mg/m³
- Test 2 at 13:40 544mg/m³

The particulate matter measured within the ERU stack comes from the sites Phoenix plant. When functioning as designed, the sites Chlorosilane Recovery Unit (CRU) should convert SiH₄, generated by phoenix, into usable Chlorosilanes, which are recovered in the Fluidised Bed Reactor (FBR) vent recovery system, prior to reaching the ERU. Any unconverted SiH₄ that is not removed in the FBR's vent recovery system is sent for combustion within the ERU and subsequently becomes silica post combustion. Prior to this incident, particulate matter was typically measuring below 1mg/m³ against a permit limit of 10mg/m³. Following the discovery of the high PM results, Dow undertook extensive work to understand the root cause.

Dow's initial root cause investigation had shown that the water flows to the ERU scrubbing column were reduced, due to a fouled heat exchanger and control valve from excess silica carryover, reducing particulate scrubbing capacity. It also identified elevated SiH₄ being sent from the FBR, due to low CRU reactor bed activity. In addition to the above, an analyser associated with the Phoenix plant, used to evaluate the Phoenix conversion chemistry had been out of service since 2018 owing to issues with the main PCB controlling the solenoids which could only be addressed by the external Vendor.

Due to the ERU's significance in keeping emissions within permitted ELV's and to the site operations as a whole, Dow undertook a review of all the previous operational data of the ERU to establish a set of KPT's (Key Performance targets) they could use to keep the plant operating and the emissions compliant while the required improvements were being arranged and completed. Dow's findings and action plan were discussed with NRW on the 22nd of March 2022 via Microsoft Teams. To establish a set of KPT's with the purpose of maintaining low particulate emissions out of the ERU, Dow undertook an assessment of their historical data.

In doing this they analysed periods of low SiH₄ while Phoenix was online and established a set of optimum conditions that they could replicate in the current system operation. During this work Dow determined that a high flow from the fluidised bed vent indicates high SiH₄ generation. Using the past information from the FT812 (kg/h) and the AT815 SiH₄ (%vol) instruments situated just after the discharge from the FBR to the ERU, Dow were able to identify an upper control limit of 0.5 kg/h for SiH₄ for the phoenix plant. Dow were also able to utilize past information to establish a pattern of the ERU Fouling factor compared with SiH₄ generation mentioned above (%vol or kg/h), consequently an upper control limit (UCL) was identified and set based on this on the ERU fouling factor. In addition to these new KPT's Dow stated that if either of the UCLs are reached, the 1st action would be reduce the reactor temperature to either kill the reaction/slow it down (Low alarm at 200oC), wait 6 hours - if UCLs still exceeded, then 2nd action is to shutdown Phoenix. In addition to the above, Dow also included regular 3rd party testing of the PM levels from emission point A41 during this period.

Following the initial incident and the implementation of the new KPT's Dow only experienced one occurrence of elevated particulate matter. However, sampling of the ERU was undertaken intermittently due to the availability of the testing company and the turnaround time of the results. In April Dow replaced the old catalyst with a new charged one and also undertook a chemical clean of the existing heat exchanger and replaced the flow valve on water flow to the scrubbing column. Following these improvements Dow experienced significantly lower particulate matter readings.

During their investigations Dow reviewed their system data relating to catalytic change out. The catalyst was replaced in April 2022 (after 51 months' service), Jan 2018 (after 44 months' service) and May 2014 (potentially the first time the catalyst was replaced post commissioning over a decade earlier – SAP and Pi records do not predate 2012). According to Dow "The CRU catalyst bed was also never designed to be a compliance related processing step, the reactor was only to recover as much product as possible via conversion of undesired species to desired species and so was only ever related to efficiency of conversion, its role in reducing particulate generating Si species has only been realised post Feb 2022". Dow were aware of the link between Phoenix/CRU operation and the fouling of the ERU boiler, but it wasn't until this incident that they were aware of the link between ERU boiler fouling and the presence of elevated particulates in the ERU vent. Evidence from their investigation supports optimum vent characteristics after the catalytic bed is refreshed. Historically the catalytic bed on the vent system had been run under the same operating conditions, however Dow are planning on investigating if further optimal running conditions can be identified and implemented to improve PM emissions from stack A41. As a result of this, CRU catalyst change out is to be placed on preventative maintenance plans and have monitoring of critical parameters, to ensure change out occurs prior to loss of reactivity. Additionally, the ERU heat exchanger change out is to be monitored via clear KPT's, to define change out prior to fouling. Dow has also purchased their own monitoring equipment so that they have the ability to undertake in-house particulates testing. Dow plan on ensuring they have the capability and certified expertise to undertake their own monitoring in the future and it is estimated that this might be in place in Q4 2022.

In basic terms the Phoenix plant is used to convert large feed molecules to smaller product molecules. According to Dow, there are several process indicators of this conversion, of which the analyser is one. Since the site has not had any previous PM issues, the analyser was not intended to be used to assess SiH₄ entering the CRU. Dow state that they are continuing to evaluate, to determine if it can generate useful reliable data. Based on their current understanding the analyser doesn't appear to provide additional insights to molecular conversion beyond other process indicators. This may change as they analyse the data further.

Since the monitoring results recorded on February 11th were significantly higher than the permitted ELV, Dow were asked to undertake a study to assess whether the elevated emissions may have led to air quality standards (AQS) being exceeded. Dow commissioned Environmental Resources Management Limited (ERM) to undertake the air quality modelling study. The modelling was undertaken using the ADMS system,

(Atmospheric Dispersion Modelling System) which is an advanced atmospheric pollution dispersion model for calculating concentrations of atmospheric pollutants and is a recognized regulatory model used in Wales. Due to the periodic nature of the PM testing the actual period over which the elevated emissions arose is unknown, Dow adopted a worst-case continuous emission scenario for this assessment. The modelled results represent a maximum impact at any location value, rather than the value at any specific sensitive receptor or off-site. The background concentration was also added to the modelled results to provide a cumulative result which was also compared to the AQS. The exercise showed that the modelled elevated emissions from the ERU incinerator are not predicted to have exceeded the air quality standards, irrespective for the period of time that the elevated emission arose.

For the 24-hour Process Contribution (PC) the result was 13% of the 24-hour PM10 standard. Dow's investigations identified that the elevated emissions are intermittent and do not arise for 24-hour periods. Furthermore, the modelled emissions were at the upper end of the anticipated emission concentration range (worst case) based on the stack testing. Therefore, taking these considerations into account the 24-hour PM10 PC is anticipated to be below the 10% of AQS screening threshold therefore, negating the need for any further assessment. For the annual mean PC, the results were only 5% of the PM10 AQS, and only 8% of the PM2.5 AQS. When the baseline is taken into consideration the PEC for both are below 70% screening threshold. These PCs are worst case as the elevated emission is intermittent and is at the upper end of the anticipated emission concentration range. Considering these factors there is therefore no need for further assessment. The results of the air-dispersion modelling have been accepted and show that the Air quality standard related to particulate matter was not exceeded during this period. As a consequence, it is deemed that the breach in ELV's for PM constitutes a maximum category 3 non-compliance.

Category 3 noncompliance is being awarded against permit condition 3.1.2. **It is an offence under Regulation 38(2) of the Environmental Permitting Regulations (consolidated 2016) to breach a permit condition or emission limit. Non-compliance score CCS3.**

Where we find non-compliance, we must identify the root cause. Where a management control is missing or has not been followed then we record the non-compliance against the permit's management system condition. Under condition 1.1.1 of Dows permit, Dow should operate a management system that identifies and minimises risks of pollution. Particulate Matter from the ERU is only required to be monitored annually and this incident is the first time an exceedance in the ELV has been observed. In this incident the management system failed to identify the risks from the various aspects of the CRU/ERU system. Upon investigating the root cause, it appears there were no KPT's, monitoring systems or operating procedures in place that functioned to understand/control or reduce PM emissions from the ERU. For the Heat exchanger, it is not fully understood how much the scrubbing column contributes to particulates removal. However, there were no planned preventative maintenance with regards to managing fouling, the unit was only cleaned when fouling became an operational issue. Dow have since implemented a 3 monthly PPM clean on both the heat exchanger (5317) and control valve (FV440). With regards to the CRU catalyst change out, Dow previously only considered the performance of the catalyst with regards to the efficiency of conversion of undesired species to desired species and not with regards to the generation of particulate matter within the ERU. As a consequence, no review was undertaken to understand how the reactivity of the catalyst relates to the concentration of the particulate emissions emitted from the ERU. Dows' recent reviews have revealed that optimum vent characteristics are experienced after the catalytic bed has been refreshed. Historically the catalytic bed on the vent system had been run under the same operating conditions, however Dow are planning on investigating if further optimal running conditions can be identified and implemented to improve PM emissions from the ERU stack.

Under permit condition 1.1.1, Dow should operate a management system that identifies and minimises risks of pollution. As mentioned at the beginning of this report, Dow have identified several KPT's that they can

incorporate into their operating procedures. Furthermore, Dow are also investigating optimal running conditions for the catalyst and have implemented planned maintenance on the heat exchanger. Had this work, to understand and control PM emissions, been undertaken as part of Dow's ongoing management reviews, then it is likely that such an incident wouldn't have occurred. As a consequence, a category 3 is being issued against Dow's management system.

Category 3 noncompliance is being awarded against permit condition 1.1.1, General Management. **It is an offence under Regulation 38(2) of the Environmental Permitting Regulations (consolidated 2016) to breach a permit condition or emission limit. Non-compliance score CCS3.**

Silicon Powder Release

NRW Received a Schedule 5 Notice on the 17th of June 2022, reporting the visible release of silicon powder from a bag filter vent during batch transfer from storage to the reactor. Dow reported that "the amount released (mainly deposited on the floor around the vent and the level below due to the density and size of the particulates) was less than 40kg. The silicon metal powder from this hopper will predominantly be > PM10". Dow reported "that as soon as the particulate release was identified, during a plant walk about, transfer was stopped and the affected lines isolated. Transfers will not be started again until the bag filters have been replaced and the valves serviced".

This incident was discussed in person with Dow's Run Plant Engineer during a compliance meeting on 11th of August 2022. The cause of the incident was related to the failure of solenoid valves associated with the nitrogen purge system. The fast opening and closing of the solenoid valve is of great importance for effective cleaning of filters and economical consumption of compressed air within the system. Prior to this incident, two of the solenoids were found to be failing with less frequent purges occurring. Upon discussion with the Run Plant Engineer the solenoids and the associated bag filters are inspected regularly within Dow's preventative maintenance plan. Due to a lack of spares stored at the site, Dow decided to operate a small continuous purge on the filter bag to try to alleviate dust build up. Unfortunately, this set up failed and led to the release of silicon powder within the immediate area.

Table S3.4 states for emission points A1-A11 gives the following permit condition "No visible releases of dust with no evidence of disposition in vicinity of stack discharge". Therefore, this incident constitutes a breach in permit condition 3.1.2 'The limits given in schedule 3 shall not be exceeded'.

Category 3 noncompliance is being awarded against permit condition 3.1.2 **It is an offence under Regulation 38(2) of the Environmental Permitting Regulations (consolidated 2016) to breach a permit condition or emission limit. Non-compliance score CCS3.**

As with all incidents where we find non-compliance, we must identify the root cause. As it states in permit condition 1.1.1, Dow's management system should identify and minimise risks of pollution, including those arising from operations and maintenance. Dow's management system should include the environmentally critical equipment within its spares management section. It appears on this occasion the root cause can be attributed to failure in having suitable spare parts which resulted in Dow operating the system in a manner in which it is not designed to. Consequently, a category 3 non-compliance is being issued against the management system as the root cause of this incident.

Category 3 noncompliance is being awarded against permit condition 1.1.1, General Management. **It is an offence under Regulation 38(2) of the Environmental Permitting Regulations (consolidated 2016) to breach a permit condition or emission limit. Non-compliance score CCS3.**

High pH to River

Details relating to this incident can be read in CAR_NRW0039941. During the compliance visit to Dow on the 11th of August we discussed and visited the affected area. The area was found to be clean and free from any liquid or debris. Dow have temporarily sealed the manhole cover above the W952 storm water line and are awaiting the arrival of bespoke covers. In the previous car form it was stated that "Dow also plan on evaluating the automation options for preventing lorries from over filling or spend beds solids from contaminating the sewer system. The introduction of the above, especially the modification of the lorry filling area should reduce the reoccurrence of this incident". This is no longer the case instead, given the proximity of the storm drains to the W1205 operational area and to prevent the situation from repeating, Dow are planning to convert these storm drains into chemical sewers.

Noise

Following a number of different noise surveys undertaken by Dow over the past few years (detailed in CAR_NRW0039941), Dow were asked to produce a plan to make improvements to the highest ranked Noise area. During the compliance meeting on the 11th of August Dow had not only created a plan but had actively targeted some of the highest scoring areas. Of note is the compressor on the fence line. Dow initially covered the compressor in sound proofing material but then discovered that the compressor was not required to be on all the time. As a result, the compressor is currently switched off. Other areas of the plant have also been addressed. There are other areas such as the Grinder Noise where the cost of reducing the noise impact is too significant. NRW is satisfied with the approach Dow is making to noise and looks forward to reviewing further improvements going forward.

W413 Passing valves

There is ongoing work to understand causes of contamination of storm water into W413 storm sump. Dow aim to look at the source to find what is causing this issue with the possible aim of turning some storm water sewers into chem sewers if needed. Until the project is complete there will be no discharge of water from W413 to river and Dow are currently treating all site storm water within the waste treatment facility.

Wastewater Treatment Plant

As mentioned in CAR_NRW0039200, high copper levels within the effluent discharge to river were attributed to several upsets within the wastewater treatment plant. Since the incident, Dow have reviewed all aspects of the treatment plant to identify all the critical elements of the plant's operation. As a result of this they feel they have a better understanding of the system and have made some improvements and plans to make the system more robust. The primary causes and discussions were attributed to the build-up of solids and hence copper throughout the various stages of the treatment system. The accumulation of solids within the Brine Ponds coupled with reduced residence time, resulted in high solids carry over into the E-tanks. During the compliance meeting on the 11th of August, we visited the primary wastewater treatment plant. During this visit the operations of a novel extraction system using de-watering filter bags was observed. As a result of using this new extraction set up, the number of solids within the E-Tank has significantly decreased. At the time of the visit Dow had begun extracting from the second E-tank. Dow are looking into ways of extracting solids from the lowest sections of the E-Tanks. These areas are more difficult due to the presence of pipework etc. Dow are also looking into ways of reducing or stopping the solids closer to the source. One of the areas they are reviewing in the installation of a filter press system adjacent to the brine ponds, this should have a significant affect in reducing solids carry over to the E-tanks.

Currently both chem sewer water and storm water are all passing through the treatment plant. The increased extraction of solids from the E-tank has an additional benefit of adding additional capacity and/or resilience to rainfall accumulation. NRW are pleased to see that the plant has remained within compliance in 2022. It is anticipated that resilience within the ETP will be further improved as Dow continue to implement the solutions stated within the root cause investigation.

Q2 Monitoring Returns

Q2 monitoring returns were received on the 28th of July 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.