



Diesel Exhaust Fluid or DEF: ADBLUE, GOCLEAR ALLIEDBLUE, AUS32,

NB: This paper has been updated making reference to changes to the classification, evidence from further research and with the latest website links shown.

To explain for the record: Diesel Exhaust Fluid (DEF) is a solution consisting of extremely high purity urea (NH₂)₂CO dissolved in de-ionised water. The ratio of the DEF mix is reasonably standardised at 32.5% urea and 67.5% de-ionised water, giving rise to the synonym AUS32 (Aqueous Urea Solution). DEF is carried in separate tanks on vehicles fitted to use the product. It is injected into the exhaust gases post combustion and then, through a catalysing system (SCR – Selective Catalytic Reduction) breaks down the air contaminant Nitrous Oxide (NO_x) emissions into nitrogen and water vapour.

The active component of DEF; Urea (Chemical Abstract Service [CAS] No. 57-13-6) has been classified by the Environmental Protection Authority (EPA) with an individual approval HSR002808 at

<https://www.epa.govt.nz/database-search/approved-hazardous-substances-with-controls/view/2075>

The Approval relates to Urea as a compound i.e. at 100%.

For the purposes of using Urea as a component at the above approximate percentages in the formulation of DEF; Dr Susan Collier Senior Advisor, Hazardous Substances Compliance Coordination Team, EPA, advised on 14th January 2014 that; ‘based on new information the EPA have reviewed the classification of urea and have recommended that the 6.1D (Acute toxicity) classification be removed.’

<https://www.epa.govt.nz/database-search/approved-hazardous-substances-with-controls/view/14747>

The resulting classification of both Urea at 100% and in AdBlue at 32.5% is listed in the manufacturers’ EPA Hazardous Substances (Safety Data Sheets) Notice 2017 compliant Safety Data Sheets (SDS) as;

- 6.3B – Substances that are mildly irritating to the skin,
- 6.4A – Substances that are irritating to the eye; and
- 9.3C – Substances that are harmful to terrestrial vertebrates

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To the question; was the removal of the (original) acute toxicity classification of 6.1D justified in the circumstances? I am assuming here that a Council Planner would not rely entirely on a SDS provided by the Resource Consent Applicant but would undertake a search of the EPA website (above) using the CAS Number as the logical and most accurate entry point to that organisation's databases.

This question has particular relevance for Council Planning staff if assessing applications by way of the Hazardous Facilities Screening Procedure (HFSP). The removal of acute toxicity exempts the product from consideration for that human toxicity hazard classification.

In answer to that question, the answer would be yes; the available literature supports that decision by the Authority.

To put that into perspective, the acute toxicity classification of the petroleum-based fuels also on the truckstop and now service station sites in question; petrol and Diesel is 6.1E with an LD50 >2,000mg but <5,000mg (per kg of body weight) by oral exposure.

Urea, if that classification of 6.1D was to have stood would have a (median) oral lethal dose for 50% of a sample population of >300mg and <2,000mg. The evidence referred to above certainly does not support that higher classification or indeed any acute toxicity classification by ingestion.

The (typical) SDS toxicological information in Section 11 of compliant 16 Part format SDS' provide the comments: 'Unlikely to cause harm if accidentally swallowed in small doses, though larger quantities may cause nausea and diarrhoea.' And; 'Ingestion of large quantities may cause nausea and diarrhoea.'

Given the main users of DEF at truckstops are commercial drivers accessing the pump by fuelcard to fill their vehicle DEF tanks, the chances of ingestion are nil. The residual chronic health effects of skin and eye irritability can be addressed by the wearing of 'protective gloves if prolonged or repeated contact is likely and safety glasses with side shields' as advised by the SDS.

Ecotoxicity:

The Ecotoxicological classification of 9.3C relates to toxicity to terrestrial vertebrates. And again, the risk of oral ingestion of DEF by animals in the quantity required to show toxic effect is effectively the same as for humans at nil under the circumstances of storage on these sites as detailed below.

If assessing applications by way of the HFSP or quantity trigger assessment plans consideration is almost always given only to HSNO Class 9.1 – Ecotoxicity in the aquatic environment. DEF falls below the EPA Hazardous Substances (Minimum Degrees of Hazard) Notice 2017 threshold and carries no 9.1 classification.

Plans may however require an assessment of risk presented by ‘environmentally damaging substances’ where a substance is able to damage an ecosystem other than by aquatic toxicity.

Depending on the aquatic receiving environment pH any discharge of urea which itself has a neutral pH may either volatilise to ammonia and carbon dioxide or hydrolyse to ammonium and the hydroxide ion. The effect of that is a short term localised mildly toxic environment from the ammonia as a slight ammoniacal smell or an increase in plant available ammonium as a fertiliser respectively.

The product does not bioaccumulate through food chains in the environment and biodegrades readily. However some studies suggest that spillages on a forecourt may concentrate the effects on drying with subsequent wash off to drains following rain likely to be sufficiently concentrated to cause environmental some concern.

DEF is not classified as environmentally hazardous according to the Australian ‘Approved Criteria for Classifying Hazardous Substances’ [NOHSC (1008)/2004 as amended and adapted].

In that DEF has no Class 9.1 aquatic toxicity classification from the EPA it is respectfully suggested that the product is exempted from HFSP calculations but rather can be assessed on the basis of risk mitigation factors alone to allow Council Planning staff to give favourable consideration to the application.

The risk assessment matters considered, and any mitigations planned, will relate in the main to aboveground tank storage. Specific issues related to belowground storage of DEF in double skin fibreglass tanks either as a separate double bulkheaded compartment of a tank storing fuels or in a standalone tank installed to applicable Safe Work Instruments and regulatory controls pursuant to the Health and Safety at Work (Hazardous Substances) Regulations 2017 as identified where applicable:

1. Products stored in 5,000 litre aboveground double contained plastic tanks shall be designed and specified for the purpose.
2. The tanks are to be placed on a contained pad with all deliveries into and out of the tank made over the pad
3. Nozzles for the delivery of product will be similar to the nozzles employed for fuel delivery therefore drivers will be familiar with the equipment.
4. DEF delivery drivers are fully trained to ensure safe filling of the tanks. The product is not classified as a dangerous good with respect to IATA (Air), IMDG (Sea), or NZS5433:2012 Transport of Dangerous Goods on Land (Road & Rail).

5. The pad containment should feed into an interceptor with manual control rather than automatic due to the miscible nature of the product as opposed to the liquid fuels. In that regard the separator unit acts as a separator for fuel but as a closed containment vessel for DEF.
6. There is no incompatibility between the fuels on site and DEF; both can be accommodated in the same interceptor.
7. There are no cumulative or synergistic effects of the co-storage of fuels and DEF on site both from the potential for chemical reaction and; due to either the liquid fuels being contained in belowground tanks with the DEF in an aboveground tank or in a separate compartment in a belowground tank.
8. Cleanout and maintenance of the interceptor should be undertaken at currently prescribed time intervals or on notification of any spill into the interceptor such that it may constitute a risk to the discharge outfall of the interceptor.
9. On unmanned truckstop sites there will be operating instructions to inform drivers to manually shut off the interceptor.
10. On unmanned sites instructions should be provided to call the maintenance contractor. Every contractor responding vehicle should have a specific DEF spill kit and staff trained in its use and in the use of PPE to address the toxicity classifications of 6.3B and 6.4A.
11. On manned sites a DEF specific spill kit should be located on site and staff trained in its use and in the use of PPE to address the toxicity classifications of 6.3B and 6.4A.
12. Hazard classification signage compliant for the purposes of emergency management needs to be placed at the sites.
13. The classification of DEF does not require any specific separation distances to boundaries for aboveground storage. There is no risk of fire or any oxidising capacity so there is no risk presented that could cross a boundary.
14. DEF tanks can be safely accommodated in people sensitive environments; if the Landuse zoning permits the truckstop or service station, the new facility and products, the subject of this application presents no additional adverse effect; in fact, the opposite as vehicular traffic employing Diesel Exhaust Fluid emit considerably less NOx in their exhaust emissions.
15. There are no fire safety requirements; and

16. Disposal if required needs to be by authorised contractors

The introduction of DEF into the New Zealand road transport scene follows worldwide trends and represents a significant opportunity to improve air quality. With modern Diesel engines normally operating under 'lean burn' characteristics today to ensure complete combustion of carbon exhaust particulates in an excess of oxygen the accompanying generation of oxides of nitrogen present significant risk to air quality. Diesel Exhaust Fluids decompose these NOx emissions, the net effect of which is to reduce New Zealand's commercial fuel consumption and increase air quality especially in our cities due to traffic density issues.

It would be my professional opinion with respect that the installation of DEF aboveground or underground tanks under the Landuse conditions described above should be treated and allowed as a Permitted Activity.

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