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August 2010

HEALTH & SAFETY INFORMATION

1. IDENTIFICATION

DEVALEX XD2 X - RAY DEVELOPER / REPLENISHER Product Code 120102

Concentrated photographic developers designed for rapid processing X-ray machines. Each case of Devalex XD2 Developer makes 2x20 litres of working strength solution on diluting with water.

Devalex XD2 comprises of three different solutions – Parts A, B and C – packed together in plastic bottles in a cardboard box, each in duplicate.

Part A	2x5 litres
Part B	2x500ml
Part C	2x500ml

2. HAZARDS

The principal concern of any product containing glutaraldehyde is that of occupational asthma. It can cause sensitisation of the skin and respiratory tract, leading to dermatitis, symptoms of hay fever, and asthma. It is also an irritant for skin, eyes, throat and lungs. It can be absorbed by the body through inhalation, ingestion or contact. The working strength developer contains about 0.3% free glutaraldehyde and the vapour should not be inhaled. Part B contains glutaraldehyde as the bisulphite complex which makes it far safer, but if this solution is mixed with alkalis (as in a spillage involving Part B then free glutaraldehyde and its vapour may be formed in substantial concentrations. Hydroquinone in Part A and the working strength solution is a skin sensitiser and toxic by ingestion; the alkalinity of these solutions will irritate eyes and skin through contact. The EU has classified hydroquinone as a Category 3 mutagen and carcinogen at concentrations above 1%, but the evidence is confined to animal tests involving high doses.

Parts B and C are moderately acidic and will similarly cause contact irritation.

The solutions are largely water, and none contain major environmental pollutants.

3. COMPOSITION

Major components are as follows. These include those defined as hazardous to health in the Control of Substances Hazardous to Health Regulations, i.e. appear in the Chemicals (Hazard Information & Packaging) (CHIP) Regulations &/or which have a maximum exposure limit or occupational exposure standard in the Health & Safety Executive document EH40. These regulations are themselves based on EC Directives of which 88/379/EEC, 67/548/EEC & 91/325/EEC are particularly relevant.

Component	CAS no.	%w/w	Symbol	Risk Phrases
Part A				
Water		40		
Hydroquinone	123-31-9	<10	Xn	36, 40, 43, 68
Potassium hydroxide	1310-58-3	< 1		
Part B				
Water		65		
Glutaraldehyde-bisulphite complex	7420-89-5	<40		
Part C				
Acetic acid	64-19-7	<20	Xi	36/38
Diethylene glycol	111-46-6	70		
1-phenyl-3-pyrazolidone (phenidone)	92-43-3	<10		52/53
Working Solution				
Water		80		
Hydroquinone	123-31-9	<3	Xn	40, 43, 68
Potassium hydroxide	1310-58-3	<1		
Diethylene glycol	111-46-6	<2		
Phenidone	92-43-3	<1		
Glutaraldehyde	111-30-8	0.3		

4. FIRST AID

Eye Contact: Irrigate the eyes with water for 15 minutes. Ensure all traces are washed out, particularly of alkaline solutions and Part C. Seek medical advice.

Skin Contact: Wash affected areas with soap and water as soon as possible. Seek medical advice if irritation persists.

Ingestion: If conscious, give water to drink and get medical advice immediately. Do not induce vomiting.

Inhalation: Remove the person to fresh air.

5. FIRE-FIGHTING

Parts A and B, and the working solution, are water-based and non-combustible. Part C is largely glycol with a flash point of 212°C; since this is above the boiling point of water it present little fire hazard, but vapour can be ignited and may explode if confined. There is no explosion hazard for Parts A and B and the working solution.

6. ACCIDENTAL RELEASE

Personal: Prevent skin and eye contact. Use respiratory and other protection as Section 8.

Environmental: In emergency the solution can be safely disposed to foul sewer by dilution with water (see Section 12).

Cleaning: Excess liquid should be absorbed with sawdust, sand or proprietary methods. Dispose of this material via incineration or waste contractor, and wash affected area with water.

7. HANDLING & STORAGE

Good general ventilation of ten or more room volume changes per hour in the work area is recommended. Storage should be at moderate temperature i.e., 5-20°C. Keep away from strong acids and alkalis.

8. PERSONAL PROTECTION

In the event of spillage, or when working in close proximity to the solutions (e.g. processor maintenance and cleaning), wear protective clothing. This should comprise an overall, rubber gloves, safety goggles to BS EN166-3S and a respirator. A half-mask respirator is satisfactory fitted with an ABEK1 filter which protects against organic vapours (such as glutaraldehyde), inorganic gases (like hydrogen sulphide), acid gases (such as acetic acid and sulphur dioxide), and ammonia (which may be released if developer and fixer mix). This level of protection is more than is required for this developer but will also protect the wearer against rapid processing fixers, likely spillages involving developer and fixer, and sulphiding silver recovery units – all of which may be encountered in processing areas.

9. PHYSICAL & CHEMICAL PROPERTIES

	Part A	Part B	Part C	Working Solution
<i>Appearance</i>	colourless	colourless	orange	straw coloured
<i>Odour</i>	none	slight	pungent	slight
<i>pH</i>	11.6	3.3	2.7	10.2
<i>Boiling point</i>	>100°C	>100°C	>100°C	>100°C
<i>Melting point</i>	none	none	none	none
<i>Flash point</i>	none	>100°C	none	none
<i>Explosive properties</i>	none	none	none	none
<i>Oxidising properties</i>	none	none	none	none
<i>Vapour pressure</i>	not determined			
<i>Specific gravity</i>	1.30	1.23	1.05	1.10
<i>Water solubility</i>	complete	complete	complete	complete
<i>Octanol/water partition</i>	not determined			

10. STABILITY & REACTIVITY

All the solutions are stable and will not polymerise. Apart from Part C they are predominantly water. Part A and the working solutions are alkaline reducers and so will react vigorously with strong acids and oxidisers. Parts B and C react vigorously with strong acids, oxidisers and strong alkalis. Sulphur dioxide may be emitted with strong acids. Thermal decomposition yields carbon dioxide, carbon monoxide and inorganic particulates.

11. TOXICOLOGICAL

The table summarises data for the hazardous components identified in Section 2.

	Oral-rat LD₅₀	Workplace Exposure Limits
<i>Hydroquinone</i>	320mg/kg	0.5mg/m ³ (Long-term)
<i>Potassium hydroxide</i>	365mg/kg	2mg/m ³ (Short-term)
<i>Acetic acid</i>	3310mg/kg	-
<i>Diethylene glycol</i>	6565mg/kg	23ppmv (Long-term)
<i>Phenidone</i>	200mg/kg	-
<i>Glutaraldehyde**</i>	134mg/kg	0.05ppmv (Long- and short-term)

mg – milligram

kg – kilogram

m³ – cubic metre

ppmv – parts per million by volume

LD₅₀ – calculated dose to kill 50% of a population of rats when taken in food or drink

The HSE has recently introduced the 'Workplace Exposure Limit' (WEL) to replace the OEL and MEL. If there is no WEL specified then the concentration should be as low as is reasonably practicable.

The hydroquinone in Part A and the working strength solution may cause skin irritation and sensitisation by contact; it is also a Category 3 carcinogen and mutagen. Ingestion will irritate the mucous membranes; 1 gram of hydroquinone may induce tinnitus, nausea or headaches, and 5-12g can be fatal. However there should be no significant inhalation risk. Potassium hydroxide in these solutions may cause eye and skin irritation

For Part C, the acetic acid may irritate eyes and skin while inhalation may irritate the upper respiratory tract. Phenidone is a poison by ingestion.

** Glutaraldehyde-bisulphite complex, as in Part B, is not regulated. However, free glutaraldehyde is present in the working strength developer at 0.3% and can be formed in higher concentration if Part B is mixed with alkalis. Glutaraldehyde is a severe skin and eye irritant which is also known to be associated with allergic reactions of the skin and respiratory tracts. Apart from acting as a potential source of glutaraldehyde, Part B is mildly acidic and may therefore cause irritation.

12. ECOLOGICAL

Background

Freshwater ecotoxicity is assessed from the effects of the substance on fish (typically rainbow trout for cold water and bluegill sunfish for warm), invertebrates (Daphnia or waterflea) and algae (especially Selenastrum capricornutum). The effects are expressed as 96hrLC₅₀, 48hrEC₅₀ and 72hrIC₅₀ values respectively (L=lethal, E=effect, I=inhibition - referring to C=concentration at which there is 50% inhibition of growth or 50% of the organisms are affected or dead after the specified interval). Units are usually milligrams per litre and any value of 100mg/l or less indicates a toxic substance.

Toxic effects are lessened if the substance degrades rapidly. Biodegradability is considered rapid if the ratio BOD₅/COD is >0.5. (BOD₅ is the biological oxygen demand imposed by the substance on natural water as it degrades over 5 days. COD is the chemical oxygen demand during complete laboratory oxidation with dichromate. High BOD or COD means a polluting substance likely to kill organisms by depleting oxygen.) Rapid degradation is also assumed if 70% of dissolved organic carbon (DOC) disappears, or if 60% of the theoretical maximum oxygen depletion (OD) or carbon dioxide generation (COG) is achieved, over a 28 day period. Abiotic degradation is also possible, e.g. photolysis.

Toxic effects are accentuated if organisms accumulate the contaminant through either the food chain or absorption from ambient media like water. Bioaccumulation potential is related to the partition of the substance between water and lipids. A useful indicator is the octanol/water partition coefficient expressed as its logarithm (logPow). If logPow ≥3.0 the substance is considered bioaccumulative unless the measured bioconcentration factor (BCF) is ≥100. (The BCF is the ratio of the concentration inside the organism compared to that in the ambient environment).

Data

The table summarises information for constituents with ecotoxicities ≥100mg/l:

		Environmental Pollutant		
		<u>hydroquinone</u>	<u>glutaraldehyde</u>	<u>phenidone</u>
toxicity (mg/l)	- LC ₅₀ (fish)	0.10	10.50	1-10
	- EC ₅₀ (Daphnia)	0.16	29.70	10
	- IC ₅₀ (algae)	1.0	no data	>10
	- interpretation	very toxic	harmful	toxic
degradability	- BOD ₅ /COD	0.53	no data	0.07
	- DOC	no data	>70%	no data
	- OD/COG	no data	no data	no data
	- abiotic	rapid	no data	no data
	- interpretation	rapid	rapid	slow
bioaccumulation	- logPow	0.59	-0.22	2.20
	- BCF	40	no data	no data
	- interpretation	not accumulative	not accumulative	not accumulative

The theoretical oxygen demand of the working strength developer is **99,600mg/litre**. (Part A concentrate 212,000; Part B 1,583,000; Part C 279,000mg/litre)

Comment

Hydroquinone is toxic but its effects vary by a factor of 1000 between species. It degrades rapidly and so does not persist; nor does it accumulate.

Glutaraldehyde is harmful to the environment but also degrades rapidly and does not accumulate.

Phenidone is toxic and degrades slowly, but does not inhibit acclimated bacteria (as in municipal sewage works) at concentrations as high as 0.2g/l. The concentration of phenidone in spent developer is around 1g/l and further dilution in the sewer system should reduce the level well below 0.2g/l. Phenidone is decomposed by sunlight (half-life 95 hours) and is reasonably soluble in water and this, together with its logPow value, suggests it will not bioaccumulate.

Other constituents are not environmentally dangerous. Although strong acids and alkalis appear toxic from tables, this is derived from their pH effects in laboratory tests rather than inherent toxicity. These effects are swamped in the environment by dilution and natural buffering. Similarly, sulphite imposes a local oxygen demand but this has little effect on the wider environment. Inorganic constituents (unless they contain a toxic metal) are non-toxic, very soluble and fully dissociated in solution. Remaining organic constituents, even if environmentally dangerous in their pure form, are present in such low concentrations as to pose little risk.

13. DISPOSAL

Heavy dilution with water will reduce the COD and moderate the pH to the extent concentrates and working solution can be discharged to sewer and meet any likely trade effluent consent. . However with the introduction of the Hazardous Waste Regulations (July 2005) hazardous waste producers may need to register with the Environment Agency. It is an offence to collect hazardous waste from non-notified premises if the producer is not exempt. For more information see the website at www.environment-agency.gov.uk
Empty bottles should be rinsed for safety and to facilitate recycling.

Except for Part B, incineration is not energy efficient as the solutions are water-based, but otherwise it is a satisfactory method of disposal yielding oxides of carbon and inorganic particulates.

14. TRANSPORT

Parts A & B are not classified as under international ADR (January 2005) and the IMDG (2004) regulations as hazardous for transport.

Part C contains acetic acid however the volume of this solution is sufficiently small for the product to be classified as 'Dangerous Goods in Limited Quantities of Class 8', UN2790 for ADR, IMDG, IATA (Acetic acid solution, > 10% < 50%)

15. REGULATORY INFORMATION

Labelling is in accordance with the Code of Practice for Classification, Packaging and Labelling of Photographic and Lithographic Processing Chemicals (European Photochemical Industry, Sector Group of CEFIC) which complies with but extends the regulations listed in Section 2 above.

Solution	Symbol	Dangerous Substance	Risk Phrases	Safety Phrases
Part A	Xn	Hydroquinone	36, 40, 43, 68	24, 37
Part C	Xi	Acetic acid	36/38, 52/53	

16. OTHER INFORMATION

Relevant risk and safety phrases are as follows:

<i>Risk</i>	–	36	Irritating to the eyes.
		36/38	Irritating to eyes and skin
	–	40	Limited evidence of a carcinogenic effect
	–	43	May cause sensitisation by skin contact
	–	68	Possible risk of irreversible effects
	-	52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
<i>Safety</i>	–	24	Avoid contact with skin
	–	37	Wear suitable gloves and eye/face protection

The symbol '**Xi**' means 'irritant' and '**Xn**' means 'harmful'.

Changes This Revision

Contact Details Updated