File No: NA/529

September 1997

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

VP Sanduvor PR-31

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

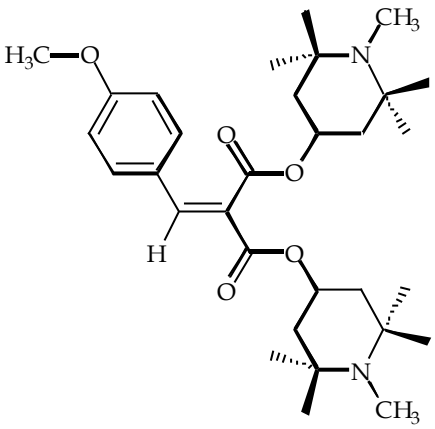
VP Sanduvor PR-31

1. APPLICANT

Clariant Australia Pty Ltd of 675-685 Warrigal Road CHADSTONE VIC 3148 has submitted a standard notification statement in support of their application for an assessment certificate for 'propanedioic acid, [(4-methoxyphenyl)methylene]-, bis(1,2,2,6,6-pentamethyl-4-piperidinyl)ester'; hereafter referred to as VP Sanduvor PR-31. No requests for exempt information relating to the content of this report were made by the notifiers and the assessment report for the notified chemical is published here in its entirety.

2. IDENTITY OF THE CHEMICAL

Chemical Name:	propanedioic acid, [(4-methoxyphenyl)methylene]-, bis(1,2,2,6,6-pentamethyl-4-piperidinyl)ester
Chemical Abstracts Service (CAS) Registry No.:	147783-69-5
Other Names:	bis(1,2,2,6,6-pentamethyl-4-piperidinyl)-2-(4-methoxy-benzylidene)malonate ALH1
Trade Name:	VP Sanduvor PR-31
Molecular Formula:	$C_{31}H_{48}N_2O_5$
Structural Formula:	



Molecular Weight:	528.8
Method of Detection and Determination:	infrared (IR), ultraviolet-visible and nuclear magnetic resonance spectra were provided for the notified chemical
Spectral Data:	characteristic peaks were found in the IR spectrum at: 1 176, 1 206, 1 218, 1 258, 1 515, 1 605, 1 704, 1 730, and 2 968 cm^{-1}

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	white crystalline powder
Melting Point:	122.2-125.8°C
Specific Gravity:	1.15
Vapour Pressure:	5.8 x 10^{-16} kPa at 25°C
Water Solubility:	31.6 ± 1.3 mg/L at 20°C
Partition Co-efficient (n-octanol/water):	log P_{ow} = 2.1 ± 0.2 at 24.5 ±1°C
Hydrolysis as a Function of pH:	$T_{1/2}$ at pH 4.0 and 9.0: not determined $T_{1/2}$ at pH 7.0: 103 hours at 25°C (see comments below)
Adsorption/Desorption:	not determined
Dissociation Constant:	pK_b = 6.8 (see comments below)
Surface Activity	59.6 mN/m at 19.8 ± 0.5°C
Particle Size:	> 100 μm 48.5% 7.5 - 100 μm 44.5% < 7.5 μm 7.5%
Flash Point:	not determined
Flammability Limits:	not flammable
Autoignition Temperature:	not autoflammable
Explosive Properties:	non-explosive

Reactivity/Stability: not oxidising

Comments on Physico-Chemical Properties

Tests were performed according to EEC/OECD test guidelines (1, 2) at facilities complying with OECD Principles of Good Laboratory Practice, with the exception of the determination of the dissociation constant (see below).

The claimed lack of solubility of the notified chemical, particularly at pH 4, is surprising, given the presence of amines within the structure. It is anticipated that these groups would be protonated at pH 4. Protonation of an amine would normally significantly increase solubility rather than decrease it. The pH at which the water solubility was quantified was not indicated.

No data on the adsorption/desorption behaviour of the notified chemical has been provided. Based on the relatively low partition coefficient of the chemical it is not anticipated that it would strongly adsorb to soils or sediment.

The dissociation constant (pK_b) was determined by titration with 0.5 N HCl in 2-methoxyethanol/water (80:20). Hence, the presented pK_b has little relevance to environmental conditions.

The notified chemical is not expected to be strongly surface active. By definition, a chemical has surface activity when the surface tension is less than 60 mN/m (2).

4. PURITY OF THE CHEMICAL

Degree of Purity: 97.5%

Impurities:

Name	*CAS Number*	*% Weight*
2[4'-methoxy-benzylidine]propanedioic acid (1",2",2",6",6"-pentamethyl-4"-piperidinyl)(2"',2"',6"',6"'-tetramethyl-4"'-piperidinyl)-ester		1.8
2[4'-methoxy-benzylidine]propanedioic acid (1",2",2",6",6"-pentamethyl-4"-piperidinyl)[methyl]-ester		0.5
2[4'-methoxy-benzylidine]propanedioic acid (2",2",6",6"-tetramethyl-4"-piperidinyl)[methyl]-ester		0.2

Additives/Adjuvants: none

5. USE, VOLUME AND FORMULATION

The notified chemical will not be manufactured in Australia. Two hundred kilos of the notified chemical (in pure form) will be imported into Australia in the first year. The import volume is expected to rise to 500 kg per annum in the subsequent four years.

The notified chemical is intended to be used as a light stabiliser for plastics (polyolefins, polystyrene and many engineering plastics), paints and coatings. One confirmed customer intends to use the chemical in gel coats (pigmented unreinforced polyester resins that are used to form the outside surface of mouldings).

6. OCCUPATIONAL EXPOSURE

The notified chemical will be imported in pure form, packed in plastic bags in fibre drums with a net weight of 25 kg. Transport workers handling unopened drums of the notified chemical will not be exposed under normal circumstances.

The notified chemical may be repacked into 5, 10 or 20 L rigid plastic containers at the notifier's warehouse prior to distribution. The notifier has provided no details regarding this repackaging process, and it is assumed that it will be carried out manually, where potential for dermal, inhalational and accidental ocular exposure may occur.

At customer sites, workers may be exposed to the notified chemical by dermal, inhalation and ocular routes while handling the powdered form, prior to incorporating into gel coats. The notified chemical will be removed from containers using a scoop, and weighed prior to mixing with other components to form the end use product. The notified chemical will be incorporated at a level of 2% in the gel coats. Workers may also be exposed to the notified chemical when applying gel coats to moulding, for example boats and other marine applications.

7. PUBLIC EXPOSURE

The public may contact the coatings on marine surfaces, for example, and minimal exposure may occur if the coatings which containing the notified chemical are damaged. In such instances the chemical is bound in the cured plastics and should not be bioavailable.

Minimal public exposure may result from disposal of unused chemical, or accidental spillage of the notified chemical during transport, storage and during formulation. However, adequate measures are described by the notifier to minimise public exposure during formulation, disposal or in the event of accidental spillage.

8. ENVIRONMENTAL EXPOSURE

Release

Under normal conditions it is not expected that the chemical would be released during storage and transportation. The Material Safety Data Sheet (MSDS) contains adequate instructions for handling a spill should one occur.

Once empty, the containers used to hold the notified chemical will be disposed of to landfill. The notifier has stated that there will be no residual chemical left in these

containers, but it is estimated that a trace of chemical (< 0.5%) would remain in the used containers. This corresponds to a maximum of 2.5 kg of the notified chemical per annum at the maximum rate of import.

The notifier claims that no waste will be generated in the formulation of the notified chemical into the gel coats. It is accepted that during formulation waste will be minimised. However, a more realistic wastage rate of up to 1% (or 5 kg per annum of the notified chemical) generated through the cleaning of equipment is possible.

The gel coats will be marketed Australia wide for use by industry. Empty containers will be disposed of to landfill. No estimate of the waste generated in the use of the gel coats has been provided. Once again it is estimated that a trace of gel coat (< 2%) would remain in the used containers. This corresponds to a maximum of 10 kg of the notified chemical per annum at the maximum rate of import.

• Fate

The substance was examined for biodegradation potential using EEC Directive 92/69, Part C.4-C (Modified Sturm Test), and OECD Test Guideline 301B (1, 2). The substance exhibited 14.1% degradation after 28 days, indicating that it is not readily biodegradable under the conditions of the test. It was also found that the notified chemical was not inhibitory to microorganisms under these conditions.

No assessment of the bioaccumulation potential of the notified chemical was provided. Based on the relatively large molecular size and ionisable nature of the chemical, the potential of the chemical to bioaccumulate is not expected to be high (3). Additionally, any potential for bioaccumulation would be mitigated by the very low exposure to the aquatic compartment.

The notified chemical is intended for use as a light stabiliser in plastics. As such, the fate of the majority of the chemical will share the fate of the plastic articles into which it is incorporated. This will be disposal to landfill or incineration at the end of the useful lifetime of the product. Incineration would destroy the chemical, and create typical decomposition products of water and oxides of carbon and nitrogen.

A small amount (< 22.5 kg per year) will be disposed of to landfill as waste from empty containers and the formulation and use of gel coats. Any chemical that is not bound within a polymer matrix has the potential to leach from landfill. However, only a small quantity (< 5 kg per annum) of free chemical which will be disposed of in this

manner. Once bound within the polymer matrix the chemical is not expected to be mobile.

No details have been provided on the extent of other uses. If used as a light stabiliser in plastics, paints and other coatings the chemical is also likely to be incorporated into high molecular weight polymers where it will immobilised.

9. EVALUATION OF TOXICOLOGICAL DATA

No toxicity data is required for chemicals which will be imported at volumes of less than 1 tonne per annum, according to the Act. However, the data summarised below were provided by the notifier.

9.1 Acute Toxicity

Summary of the acute toxicity of VP Sanduvor PR-31

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat	LD_{50} = 2 195 mg/kg (combined sexes)	(4)
acute dermal toxicity	rat	LD_{50} > 2 000 mg/kg	(5)
skin irritation	rabbit	non-irritant	(6)
eye irritation	rabbit	slight irritant	(7)
skin sensitisation	guinea pig	non-sensitising	(8)

9.1.1 Oral Toxicity (4)

Species/strain:	rat/Wistar
Number/sex of animals:	5/sex
Observation period:	14 days
Method of administration:	gavage
Clinical observations:	all animals showed signs of sedation and ruffled fur after treatment with the test material and a number of animals developed a hunched posture; one female and one male treated with 1 000 mg/kg developed ventral recumbency; clinical signs in surviving animals had disappeared by day 3 two males and three females treated with 2 000 mg/kg developed ventral recumbency; four males and two females developed dyspnoea; clinical signs had disappeared by day 4 in surviving animals

Mortality: all deaths occurred within three days of administration of the test substance

Dose (mg/kg)	***Deaths (m/f)***
500	0/0
1 000	1/2
2 000	2/2

Morphological findings: no findings were noted for surviving animals treated with 500 and 1 000 mg/kg; a surviving female and a male treated with 2 000 mg/kg showed reddish discolouration of the jejunum.

a number animals which died after being dosed with 1 000 and 2 000 mg/kg showed abnormalities in the jejunum, lungs and stomach; one animal in the former range also showed abnormalities in the duodenum/ileum

Test method: similar to OECD guidelines (1)

LD_{50}: 2 195 mg/kg (combined sexes)

Result: the notified chemical is of low oral toxicity to rats

9.1.2 Dermal Toxicity (5)

Species/strain: rat/Wistar

Number/sex of animals: 5/sex

Observation period: 14 days

Method of administration: single semi-occlusive dermal application

Clinical observations: nil

Mortality: nil

Morphological findings: nil

Test method: similar to OECD guidelines (1)

LD_{50}: > 2 000 mg/kg

Result: the notified chemical was of low dermal toxicity to rats

9.1.3 Inhalation Toxicity

No inhalation toxicity data were provided by the notifier.

9.1.4 Skin Irritation (6)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	1 male/2 females
Observation period:	72 hours
Method of administration:	4 hour semi-occlusive dressing application using 0.5 g of notified chemical
Draize scores (9):	all Draize scores at all time points were zero
Test method:	similar to OECD guidelines (1)
Result:	the notified chemical was not a skin irritant in rabbits

9.1.5 Eye Irritation (7)

Species/strain:	rabbit/New Zealand White
Number/sex of animals:	1 male, 2 females
Observation period:	14 days
Method of administration:	0.1 g of the notified chemical was placed in the conjunctival sac of the left eye of each animal; right eye served as a control
Draize scores (9) of unirrigated eyes:	see table on next page
Test method:	similar to OECD guidelines (1)
Result:	the notified chemical was a slight eye irritant in rabbits

	Time after instillation														
Animal	**1 day**			**2 days**			**3 days**			**7 days**			**14 days**		
Cornea	**o[a]**	**a[b]**		**o[a]**	**a[b]**		**o[a]**	**a[b]**		**o[a]**	**a[b]**		**o[a]**	**a[b]**	
1	0			0			0			0			0		
2	1			1			2			0			0		
3	1			1			2			0			0		
Iris															
1	0			0			0			0			0		
2	0			0			1			0			0		
3	0			0			1			0			0		
Conjunctiva	**r[c]**	**c[d]**	**d[e]**	**r[c]**	**c[d]**	**d[e]**	**r[c]**	**c[d]**	**d[e]**	**r[c]**	**c[d]**	**d[e]**	**r[c]**	**c[d]**	**d[e]**
1	0	0		0	0		0	0		0	0		0	0	
2	2	1		2	1		2	2		1	0		0	0	
3	2	2		2	2		2	2		1	1		0	0	

[1] see Attachment 1 for Draize scales
[a] opacity [b] area [c] redness [d] chemosis [e] discharge

9.1.6 Skin Sensitisation (8)

Species/strain: guinea pig/albino

Number of animals: 20 test; 10 control

Induction procedure: Day 1: three pairs of intradermal injections:

- 0.1 mL Freund's complete adjuvant (FCA)/physiological saline (1:1 (v/v))
- 0.1 mL of 5% concentration of notified chemical with ethanol
- 0.1 mL of 5% concentration of notified chemical in FCA and physiological saline

Day 7: test area treated with 10% sodium-lauryl-sulfate (SLS) in liquid paraffin

Day 8: occluded application of the notified chemical (50% (w/w) ethanol) for 48 hours

Challenge procedure: Day 22: occluded application of notified chemical (50% (w/w) ethanol) for 24 hours

Challenge outcome:

Challenge concentration	Test animals		Control animals	
	24 hours*	48 hours*	24 hours	48 hours
50%	**0/20	0/20	0/10	0/10

* time after patch removal
** number of animals exhibiting positive response

Test method: similar to OECD guidelines (1)

Result: the notified chemical was not a skin sensitiser in albino guinea pigs

9.2 Repeated Dose Toxicity (10)

Species/strain: rat/Wistar

Number/sex of animals: 20/sex (5/sex/dose group)

Method of administration: gavage; vehicle distilled water

Dose/Study duration:: the test substance was administered daily for a period of 28 days:

control: 0 mg/kg/day
low dose: 50 mg/kg/day
mid dose: 200 mg/kg/day
high dose: 500 mg/kg/day

all animals were sacrificed at the end of the treatment period

Clinical observations: no treatment-related findings

Clinical chemistry/Haematology higher cholesterol and phospholipid concentrations were noted in females in the mid-dose group

Histopathology: animals in the high dose group were found to have oedema, inflammatory cell infiltration, ulcer and gastritis in the forestomach

Test method: similar to OECD guidelines (1)

Result: oral administration of the notified chemical at a dose level of 500 mg/kg for 28 days induced localised changes in the forestomach of Wistar rats

9.3 Genotoxicity

9.3.1 *Salmonella typhimurium* Reverse Mutation Assay (11)

Strains:	*Salmonella typhimurium* TA 1535, TA 1537 TA 98 and TA 100
Concentration range:	1.0 - 5 000 µg/plate (with or without S9 mix)
Test method:	similar to OECD guidelines (1)
Result:	the notified chemical was not mutagenic in the bacterial strains tested in the presence or absence of metabolic activation provided by rat liver S9 fraction

9.3.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (12)

Species/strain:	mouse/NMRI
Number and sex of animals:	30/sex (5/sex/test group)
Doses:	24 hour preparation interval: 150, 500 and 1 500 mg/kg 48 hour preparation interval: 1 500 mg/kg
Method of administration:	oral administration; vehicle was polyethylene glycol
Test method:	similar to OECD guidelines (1)
Result:	the notified chemical did not induce micronuclei in the bone marrow cells of the mouse; positive controls showed appropriate increases in induced micronucleus frequency

9.3.3 Chromosomal Aberration Assay in Chinese hamster V79 cells (13)

Dosing schedule:	with S9 mix: 2.5-40 µg/mL - cells were treated with the test material for 4 hours without S9 mix: 1.0-15 µg/mL - cells were treated with the test material for 18 or 28 hours chromosomes were prepared 18 or 28 hours after the start of treatment with the test

	material
Test method:	similar to OECD guidelines (1)
Result:	increases in cells with structural aberrations were seen after treatment with the test article at doses at and above 10 μg/mL, in the presence or absence of metabolic activation the test material was considered to be clastogenic under the conditions of this chromosome aberration test

9.4 Overall Assessment of Toxicological Data

The notified chemical was of low oral and dermal toxicity in rats (oral LD_{50} = 2 195 mg/kg (combined sexes); dermal LD_{50} > 2 000 mg/kg). No inhalation toxicity data were provided by the notifier. The notified chemical was not a skin irritant in rabbits, but caused slight eye irritation in the same species. The notified chemical was not a skin sensitiser when tested in guinea pigs. Oral administration of high doses (500 mg/kg/day) to rats for 28 days induced localised changes in the forestomach.

The notified chemical was not found to be mutagenic in bacteria and did not induce micronuclei in an *in vivo* mouse micronucleus assay. Clastogenic effects were seen, however, in an *in vitro* Chinese hamster V79 cell assay.

On the basis of the toxicity studies summarised above, the notified chemical would not be classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* (14).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The notifier has provided the following ecotoxicity studies as part of the notification package. The tests were carried out according to OECD Test Methods (1) and are summarised on the following page.

Species	***Test***	***Results***
Rainbow Trout *Oncorhynchus mykiss*	Acute Toxicity (OECD Method 203)	LC_{50} = 0.7 mg/L (96 hour) NOEC = 0.3 mg/L (96 hour) LOEC = 0.6 mg/L (96 hour)
Daphnia magna	Acute Immobilisation (OECD Method 202, Part 1)	EC_{50} > 46.5 mg/L (48 hour) NOEC = 1.6 mg/L (48 hour)
Algae *Scenedesmus subspicatus*	Growth Inhibition (OECD Method 201)	NOEC > 60 mg/L (72 hour)
Aerobic Waste Water Bacteria	Respiration Inhibition (OECD Method 209)	EC_{50} > 100 mg/L (30 minutes)

In the fish acute toxicity test, sublethal effects were observed at measured concentrations above 1.2 and 2.0 mg/L after 48 and 24 hours, respectively. These effects included strong ventilation and changed body colour. After 48 hours, at 1.2 mg/L, two out of the seven fish exposed were showing the sublethal effects, by 72 hours five fish had died and the remaining two were showing symptoms. At 2.0 mg/L two out of the seven fish exhibited sublethal effects and by 48 hours all seven fish had died.

In the acute immobilisation test for *Daphnia* the maximum observed immobilisation was 30% at a measured concentration of 46.5 mg/L of the test substance. Hence, the EC_{50} for Daphnia is greater than 46.5 mg/L.

In the algal growth inhibition test, the growth rates up to and including the highest tested concentration (60 mg/L) were not statistically different from the control. Hence, the algal NOEC is greater than 60 mg/L.

The notified chemical showed only slight inhibition (2.3-9.3%) to the respiration rate of aerobic waste water bacteria at nominal concentrations ranging from 10 to 100 mg/L. Hence the EC_{50} is greater than 100 mg/L.

The ecotoxicity data for the notified chemical indicate that it is highly toxic to fish but only slightly toxic to *Daphnia*. No toxic effects were observed for algae at concentrations around the water solubility of the chemical. The activated sludge respiration inhibition test indicated that the chemical only slightly inhibits the respiration of microorganisms at concentrations above the water solubility of the chemical.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The notified chemical will be used as a light stabiliser for plastics, paints and coatings. Once incorporated into these products the notified chemical is expected to remain within the product matrices. Hence, the majority of the notified chemical will share the fate of the articles into which it is incorporated. It is anticipated that these will be disposed of to landfill or incinerated at the end of the useful lifetime of the product. In landfill it is expected that the notified chemical will remain immobile within the matrices.

Waste from empty containers, the formulation and use of gel coats (total less than 22.5 kg per annum) will be disposed of to landfill where it is expected that it will be immobile. Hence the overall environmental hazard of the chemical can be rated as low, given the low environmental exposure.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The occupational health risk posed to transport workers handling unopened containers of the notified chemical is negligible, given the lack of exposure and low hazard posed by the notified chemical.

There is a low occupational health risk for workers who will be handling the notified chemical in pure, powdered form. As a proportion of the particles (approximately 7.5%) fall into the range considered to be respirable (cited in (15)), and there is no information available regarding the inhalation toxicity of the notified chemical, care should be taken to avoid the generation of dust when handling the chemical in powdered form. Based on the results of animal studies, workers may experience slight eye irritation if ocular exposure occurs.

Once the chemical is part of a gel coating product, the occupational risk is reduced, as inhalation exposure will be unlikely, and the notified chemical will be at a low concentration (2%) within the coating.

Minimal public exposure may result following contact with surfaces covered by the coatings, or accidental removal of the coating due to damage. However, the chemical is bound in the matrix of the coating and as such would pose a negligible public risk. There is potential for minor public exposure during formulation, transport and disposal of the chemical if accidentally spilt. This is minimised by the recommended practices during formulation, storage and transportation.

13. RECOMMENDATIONS

To minimise occupational exposure to VP Sanduvor PR-31 the following guidelines and precautions should be observed:

- It is good work practice to wear industrial clothing which conforms to the specifications detailed in Australian Standard (AS) 2919 (16) and occupational footwear which conforms to Australian and New Zealand Standard (AS/NZS) 2210 (17) to minimise exposure when handling any industrial chemical;

Spillage of products containing the notified chemical should be avoided, spillages should be cleaned up promptly and put into containers for disposal;

- Good personal hygiene should be practised to minimise the potential for ingestion;

- A copy of the MSDS should be easily accessible to employees.

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14. MATERIAL SAFETY DATA SHEET

The MSDS for the notified chemical was provided in accordance with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (18).

This MSDS was provided by the applicant as part of the notification statement. It is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the Act, secondary notification of the notified chemical shall be required if any of the circumstances stipulated under subsection 64(2) of the Act arise. No other specific conditions are prescribed.

16. REFERENCES

1. Organisation for Economic Co-operation and Development 1995-1996, *OECD Guidelines for the Testing of Chemicals on CD-Rom*, OECD, Paris.

2. European Economic Community (EEC) 1992, 'Methods for the Determination of Physico-Chemical Properties', in *EEC Directive 92/69, Annex V, Part A, EEC Publication No. L383*, EEC.

3. Connell, D.W. 1989, 'General characteristics of organic compounds which exhibit bioaccumulation', in *Bioaccumulation of Xenobiotic Compounds*, CRC Press, Boca Raton.

4. Mahl, A. 1993, *Acute Oral Toxicity Study with ALH-1*, Project no., 351011, RCC Group, Huningue.

5. Pfister, T. 1995, *Acute Dermal Toxicity Study with VP SANDUVOR PR 31 in Rats*, Project no., 391274, RCC Group, Itingen.

6. Arcelin, G. 1993, *Primary Skin Irritation Study with ALH-1 in Rabbits*, Project no., 351033, RCC Group, Itingen.

7. Arcelin, G. 1993, *Primary Eye Irritation Study with ALH-1 in Rabbits*, Project no., 351022, RCC Group, Itingen.

8. Arcelin, G. 1995, *Contact Hypersensitivity to VP SANDUVOR PR 31 in Albino Guinea Pigs - Maximisation Test*, Project no., 391285, RCC Group, Itingen.

9. Draize, J.H. 1959, 'Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics', *Association of Food and Drug Officials of the US*, vol. 49, pp. 2-56.

10. Pfister, T. 1995, *Subacute 28-Day Oral Toxicity (Gavage) Study with VP SANDUVOR PR 31 in the Rat*, Project no., 391296, RCC Group, Itingen.

11. Poth, A. 1993, *Salmonella Typhimurium Reverse Mutation Assay with ALH-1*, Project no., 419905, RCC Group, Itingen.

12. Volkner, W. 1995, *Micronucleus Assay in Bone Marrow Cells of the Mouse with VP SANDUVOR PR 31*, Project no., 523000, RCC Group, Itingen.

13. Czich, A. 1995, *Mutagenicity - In Vitro Chromosome Aberration Assay in Chinese Hamster V79 Cells with VP SANDUVOR PR 31*, Project no., 501008, Itingen

14. National Occupational Health and Safety Commission 1994, *Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1994)]*, Australian Government Publishing Service, Canberra.

15. National Occupational Health and Safety Commission 1995, 'Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment, [NOHSC:1003(1995)]', in *Exposure Standards for Atmospheric Contaminants in the Occupational Environment: Guidance Note and National Exposure Standards*, Australian Government Publishing Service, Canberra.

16. Standards Australia 1987, *Australian Standard 2919-1987, Industrial Clothing*, Standards Association of Australia, Sydney.

17. Standards Australia/Standards New Zealand 1994, *Australian/New Zealand Standard 2210-1994, Occupational Protective Footwear*, Standards Association of Australia/Standards Association of New Zealand, Sydney/Wellington.

18. National Occupational Health and Safety Commission 1994, *National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011(1994)]*, Australian Government Publishing Service, Canberra.

Attachment 1

The Draize Scale for evaluation of skin reactions is as follows:

Erythema Formation	*Rating*	*Oedema Formation*	*Rating*
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1 mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

The Draize scale for evaluation of eye reactions is as follows:

CORNEA

Opacity	*Rating*	*Area of Cornea involved*	*Rating*
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE

Redness	*Rating*	*Chemosis*	*Rating*	*Discharge*	*Rating*
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS

Values	*Rating*
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe