



Substitution list for hazardous chemicals

The National Substitution Group for Chemical Products (NSG Chemical Products) is a network of people from different county/regional councils and universities who are working on issues relating to chemicals from a health and environment perspective. The group aims to find and promote substitutes for hazardous chemicals.

Substitutions can be made in many different operations, and our substitution list is thus divided into four sections representing different areas:

Laboratory chemicals
Health care
Cleaning/disinfection
Miscellaneous

This document lists substitutions that have been successfully implemented in the specified operation. Thus, they are meant to be good examples that can be implemented elsewhere. However, there is no guarantee that the substitutions below will work in other contexts; each operation must test and evaluate a possible substitution.

If you have any suggestions for substitutions that you would like to share, please contact one of the following people and we will add your suggestion to the list:

Anders Bolmstedt, Västra Götalandsregionen, anders.bolmstedt@vgregion.se
Julia Axengren, Västra Götalandsregionen, julia.axengren@vgregion.se

If you would like to know more about the group's work, please visit our website!
<http://www.vgregion.se/nsg>

Laboratory chemicals

Product substitution of laboratory chemicals

Pink background = CMR product

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Boric acid in TBE buffer CAS: 10043-35-3	In buffer for gel electrophoresis.	Boric acid may cause birth defects and reproductive toxicity.	Acetic acid (TAE buffer) CAS: 64-19-7	TAE buffer is slightly worse than TBE buffer for certain separations.	Akademiska sjukhuset, Klinisk mikrobiologi
Blue gel/silica gel (cobalt chloride) CAS: 7646-79-9	Dehumidifier with humidity indicator.	Colour indicator: cobalt chloride.	Safe-gel, yellow/orange silica gel with yellow or orange humidity indicator	Colour indicator: iron salts.	Klinisk Kemi SU
Brilliance candida selective supplement SR0231	Substrate for differentiation of yeasts.	CMR product (R45) Contains chloramphenicol. CAS: 56-75-7 H350	Chromagar Candida (CA222)	Works well; has been used in Växjö before without problems. Causes eye, skin and respiratory tract irritation.	Mikrobiologen Karlskrona Johanna Bergström, miljösamordnare
Chloramphenicol antimicrobial supplement, CAS: 56-75-7 New 2023-11-27	Making agar plates	CMR product H350	Chloramphenicol Ready Made Solution 100 mg/mL	Works well, prepared solution. H351 Suspected of causing cancer	Klinisk mikrobiologi, Region Östergötland
Cycloheximide Solution 50 mg/mL, CAS: 66-81-9 New 2023-11-27	Making DTM-agar plates	CMR product H360D	Dermatophyte Agar	Prepared culture plates, works well.	Klinisk mikrobiologi, Region Östergötland
Detergent, Extran	Cleaning of laboratory equipment.	Nitritotriacetic acid (NTA). CAS: 139-13-9	Same product but with altered content	The supplier does not want to say what the new substance is, but it is supposed to be less hazardous.	Universitetssjukhuset i Lund
Dimethyl formamide CAS: 68-12-2	Analysis of alkaline phosphatase in leukocytes. Used to dissolve naphthol AS phosphate.	CMR product H360D.	Ethanol CAS: 64-17-5	Naphthol AS phosphate is slightly slower to dissolve in ethanol.	Klinisk Kemi SU
DPX mounting medium		CMR product H360Df.	Pertex mounting medium	Contains xylene and ethylbenzene.	Klinisk kemi, Region Kronoberg
Ethidium bromide CAS: 1293-45-8	Visualisation (staining) of DNA and RNA.	Risks include splashes in the eyes, but above all, inhalation of dust from dried-up EtBr from corks, spills, dye baths, bags, equipment, etc. This also applies during waste management.	GELRED in water (Bionuclear)	Modified so as not to penetrate cell membranes.	Folkhälsomyndigheten Göteborgs Universitet, Sahlgrenska akademien

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
			Gel Star Nucleic Acid Gel Stain	More sensitive than EtBr, strands become visible without UV light. Dissolved in DMSO, thus labelled an irritant.	Klinisk Kemi SU
			SYBR Safe	The strand resolution is comparable to that of equivalent products containing EtBr.	Landstinget i Östergötland
					Göteborgs Universitet, Sahlgrenska akademien
Fast Blue B salt CAS: 20282-70-6	Analysis of Aflatoxins, fungi.	CMR product, H350.	Fast Blue BB salt hemi (zinc chloride) salt CAS:5486-84-0	Contains 4-(Benzoylamino)-2,5-diethoxybenzenediazonium tetrachlorozincate. Suspected carcinogen, H351.	Klinisk kemi, Region Kronoberg
Phenylmethanesulfonyl fluoride, PMSF CAS: 329-98-6	Used as protease inhibitor in Western blotting.	Toxic and corrosive.	"Pefabloc" 4-(2-aminoethyl)benzenesulfonyl fluoride hydrochloride, AEBF CAS: 30827-99-7	Pefabloc worked just as well or even better. Not classified as toxic, only corrosive.	Uppsala universitet
Formaldehyde CAS: 50-00-0	Testing and analysis of parasites.		ParasiTrap Dual		Linköpings universitet
Formamide CAS: 75-12-7	Denaturation of FISH glass. Fluorescent in situ hybridisation.	CMR product H360D.	NaOH & ethanol CAS: 1310-73-2 CAS: 64-17-5	NaOH in 70% ethanol. Then 70%, 90% and absolute alcohol.	Göteborgs Universitet, Sahlgrenska akademien
Formamide CAS: 75-12-7	Fragment analysis on ABI373xl (capillary instrument from Life Technologies).		EDTA 0,1 mM pH 8	Slightly stronger signal strength. The analysis must be run a little faster, as EDTA evaporates faster, but there is no need to work inside a fume hood.	Uppsala universitet
n-Hexane CAS: 110-54-3	E.g. HPLC	n-Hexane is particularly hazardous to the peripheral nervous system.	Heptane CAS: 142-82-5 Pentane CAS: 109-66-0	In many applications, n-Hexane can be substituted for another solvent.	Klinisk Kemi SU

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Hydrazine sulphate CAS: 10034-93-2	Calibrator for water analysis.		Stable calibrator		Uppsala universitet
Immersion oil with chlorinated paraffins and phthalates, e.g. Zeiss Immersol 518 F CAS: 84-74-2 (dibutyl phthalate) CAS: 63449-39-8	Microscopy.		Immersion oil with benzyl benzoate, e.g. Zeiss Immersol 518 N CAS: 120-51-4		Akademiska sjukhuset, flera labb
Carbol fuchsin solution CAS: 632-99-5	For gram staining of bacteria.	Solution in ethanol or water.	Safranin CAS: 477-73-6	Works on bacteria, but not on malaria parasites.	Karolinska Universitetssjukhuset
					Akademiska sjukhuset, Klinisk mikrobiologi
Kanamycin sulphate CAS: 25389-94-0	Select gram-negative anaerobic bacteria.	CMR-product. H360.	Kanamycin solution (Sigma, K0254)	Still kanamycin (CMR), but prepared solution reduces the handling of the substance.	Mikrobiologen Karlskrona
Chloroform CAS: 67-66-3	RNA isolation.		Bromochloropropane (BCP) CAS: 109-70-6		Klinisk Kemi SU
Chromic acid (Parengy's decalcification solution) CAS: 1333-82-0	Decalcification solution for decalcifying bones during pathological work.	Chromic acid (chromium trioxide) is carcinogenic, mutagenic, allergenic, hazardous to the environment, suspected to cause reproductive damage, etc. Chromic acid is included in the Annex XIV list of licensed chemicals in REACH.	Hydrochloric Acid (Decalcifying Solution) CAS: 7647-01-0		Region Jönköpings Län, Avd för Klinisk Patologi Akademiska sjukhuset, Avd för Klinisk Patologi
Mercuric chloride CAS: 7487-94-7	Analysis of metabolic diseases.	Very toxic, hazardous to the environment. Requires exemption from the Swedish Chemicals Agency (KemI).	Silver nitrate CAS: 7761-88-8	Also hazardous to the environment, but disposed of as hazardous waste.	Klinisk Kemi SU

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Lactophenol aniline blue CAS: 108-95-2 (phenol)	Staining (in mycology).		Metylblue 0.1% in lactic acid CAS: 28983-56-4(metylblue)		Karolinska Universitetssjukhuset
Medical petroleum CAS: 64742-49-0	Cleaning of medical equipment.		Ethanol, mild soap solution CAS: 64-17-5		Karolinska Universitetssjukhuset
	Removal of immersion oil.		Ethanol, 70% CAS: 64-17-5		Mikrobiologen, Uddevalla sjukhus
			Window cleaner	Any brand can be used.	Linköpings universitet
2-Mercaptoethanol CAS: 60-24-2	Reducing agent, used to prepare samples for electrophoresis, etc.	Very volatile, harmful through inhalation and skin contact, hazardous to the environment.	1.4-Dithiothreitol CAS: 3483-12-3		Karolinska Universitetssjukhuset, Gunilla Buss gunilla.buss@SLL.se
					Folkhälsomyndigheten
	RNA extraction with Qiagen's kit.				Region Jönköpings län, laboratoriemedicin
Metronidazole CAS: 443-48-1 New 2023-11-27	Making agar plates	CMR-product H350	Metronidazole 5 mg/mL	Works well, prepared solution.	Klinisk mikrobiologi, Region Östergötland
Methanol CAS: 67-56-1	Fixation of gels.	Toxic.	Ethanol CAS: 64-17-5	Did not work well in trials with PVDF membranes.	Folkhälsomyndigheten
				Fix: 3 parts absolute ethanol + 1 part acetic acid.	Göteborgs Universitet, Sahlgrenska akademien
2-Methoxyethanol CAS: 109-86-4	Analysis, dual esterase.	Licensed substance, included in the AV Group B list.	Ethanol 99% CAS: 64-17-5	We first switched to 2-Ethoxyethanol, but have now been able to replace this with pure ethanol.	Klinisk Kemi SU
Petroleumether CAS 64742-49-0	lipidanaysis	Chemsec SIN-list	2-metylpentan CAS: 107-83-5 n-pentan CAS: 109-66-0		Klinisk Kemi SU

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Picric acid CAS: 88-89-1	Fixation.	Explosive when dry, toxic.	Mixture of ethanol, acetic acid and water CAS: 64-17-5 CAS: 64-19-7	Fixation and destaining liquid.	Universitetssjukhuset i Lund, Klinisk mikrobiologi
Thiomersal CAS: 54-64-8	Preservative.	Contains mercury.	Sodium azide CAS: 26628-22-8	NB! A general ban on mercury is in effect, but chemicals for analysis may be sold until 31 December 2014.	Karolinska Universitetssjukhuset
Triton-x-100 CAS: 9002-93-1	Immunohistochemical staining Triton can be used as a detergent or for lysis of cells.	Environmentally hazardous substance and also subject to a permit from ECHA also for laboratories	Tween 20 CAS: 9005-64-5	Non-hazardous substance. The substitution worked for some antibodies but not all, must be tested.	Karolinska institutet
Trypan blue CAS: 72-57-1	viability stain for manual cell counting	CMR-product	Erythrosin extra bluish (Sigma E8886) CAS: 16423-68-0	H411 Toxic to aquatic life with long lasting effects. H302 Harmful if swallowed Less hazardous	Karolinska institutet
Xylene CAS: 1330-20-7	Histology lab: deparaffinisation of tissue sections before staining.		X-tra Solv and X-tra Kit	When X-tra Solv is used instead of Xylene, the product X-tra Kit is also required when mounting sections on slides.	Karolinska Universitetssjukhuset
Xylene CAS: 1330-20-7	Histolab: dehydration of tissue samples before embedding paraffin.		Isopropanol CAS: 67-63-0		Göteborgs Universitet, Sahlgrenska akademien

Reduction or substitution of laboratory chemicals through a change of methods

Method / Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Acetonitrile, n-Hexane and other solvents CAS: 75-05-8	HPLC		-	Reduced use due to switch to LC-MS/MS. 2010-09-28	
Acrylamide gel (to be cast) CAS: 79-06-1			Acrylamide gel (pre-cast)	Pre-cast gels contain significantly lower quantities of un-polymerised acrylamide. The substitution has clear work environment benefits, but we have not researched the potential environmental benefits.	Karolinska Universitetssjukhuset,
Dichloromethane CAS: 75-09-2	Liquid-phase extraction.		-	Reduced use due to switch to solid-phase extraction. 2010-09-28	Universitetssjukhuset i Lund
Silver nitrate CAS: 7761-88-8	Developer solution for proteins and DNA acrylamide gels (PAGE).	Particularly suitable for small amounts of DNA or proteins.	Hydragel Isofocusing from SEBIA, for isoelectric focusing (IEF), special instruments + kits are often available.		Universitetssjukhuset i Lund
96-hole plates	E.g. sequencing, fragment analysis, PVR reactions.		384-hole plates	Saves both chemicals and plastic when you have large series of samples. Requires a robot for pipetting.	Göteborgs Universitet, Sahlgrenska akademien
Fluorochromes	DNA sequencing.		The volume of flourochromes can be reduced compared to the recommended quantity.	5µL instead of 10 or 20 µL works well. Then 1 µL terminator/reaction is sufficient.	Göteborgs Universitet, Sahlgrenska akademien
32P isotopes	In LOS (Loss of Heterozygosity) and fragment analysis.		Fluorochromes		Göteborgs Universitet, Sahlgrenska akademien

Method / Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Mercuric chloride CAS: 7487-94-7	Sampling of methane in sea water and sediments.	Very toxic, hazardous to the environment. Requires exemption from the Swedish Chemicals Agency (KemI).	Zinc chloride CAS: 7646-85-7	Corrosive, hazardous to the environment. Listed in the KemI PRIO database (but still better than mercury).	Stockholms universitet
EPON (embedding plastic) Bisphenol A diglycidyl ether CAS: 25068-38-6 Propylene oxide CAS: 75-56-9	Making thin sections of soft tissue. Embedding in plastic for better morphology and ultrathin sections (3 µm). Alcohol and propylene oxide required for dehydration.		LR-White (embedding plastic) Ethanol CAS: 64-17-5	LR-white is a gentler plastic. Dehydration solely with alcohol.	Göteborgs Universitet, Sahlgrenska akademien
Trichloroacetic acid CAS: 76-03-9	Fixation of acrylamide gels.		Hydragel Isofocusing from SEBIA, for isoelectric focusing (IEF), special instruments + kits are often available		Karolinska Institutet
			The TCA fix bath can be used many times, and the amount can thus be reduced considerably.		Klinisk Kemi SU
Water suction			Membrane pump for rotary evaporator is an alternative to water pump	Significant reduction of the quantity of solvent flushed down the drain. The solvent is condensed and can be collected (Vacubrand is sold by Labinett).	SUs Lund
Real-time PCR			TLDA card	5-10 times less reagent is used.	Göteborgs Universitet, Sahlgrenska akademien
Kanamycin sulphate CAS: 25389-94-0	For selective cultivation of anaerobic bacteria.	Kanamycin may cause birth defects. Kanamycin is classified as a so-called CMR substance.	Operations have stopped using selective anaerobic culture plates. Today, only nutritious blood agar is used, adapted for the cultivation of anaerobic bacteria. Two antibiotic discs are placed on the cultivated sample (metrodinazol and tobramycin).	It is okay to only use anaerobic agar. It has been necessary to further identify the anaerobic bacterium even when using a selective medium, and now there is Maldi-Tof, which provides quick answers when identifying species.	Akademiska sjukhuset, Klinisk mikrobiologi,

Method / Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Electro etching Nitric acid 33%			Nitric acid 3%	An etching method that uses 10 times weaker acid has been developed.	Göteborgs Universitet, Sahlgrenska akademien
Phenol [108-95-2]	Analysis of ammonium in salt water.	Toxic, hazardous to the environment and suspected mutagen.	Sodium salicylate [54-21-7]	The method requires a bit more precision.	Stockholms universitet
Pepsin [9001-75-6] and formaldehyde [50-00-0]	FISH-Fluorescence in situ hybridisation	Used as pre-treatment of slides	Removed completely, it works well without it	Does not work on paraffin-embedded material	Region Skåne, medicinsk Service

Health care

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Hydroquinone (in developer solution) CAS: 123-31-9	Developing agent for photographic film.		Developer solution without hydroquinone	Reduced use due to transition to digital x-ray. 2009-02-02	Region Uppland Akademiska sjukhuset,
Chromium trioxide CAS: 1333-82-0	Etching of blood vessels in case of severe epistaxis.	The handling of chromium trioxide is covered by AFS 2005:17 § 26 and § 27.	Silver nitrate (lapis) sticks CAS: 7761-88-8		Akademiska sjukhuset, Öron-näsa-hals-mottagning, samt Primärvården, Region Uppland
Medical petroleum CAS: 64742-49-0	Cleaning of medical equipment.		Ethanol, mild soap solution CAS: 64-17-5		Karolinska Universitetssjukhuset,
	Removal of plaster residue.		Remove		Karolinska Universitetssjukhuset,
	Removal of plaster residue.		KMI-Häftremover		KK-Operation, Sahlgrenska Sjukhuset,
Nail polish remover	Removal of nail polish.	Contains acetone, ethyl acetate, isopropyl myristate, etc.	KMI-Häftremover		KK-Operation, Sahlgrenska Sjukhuset,
Thiomersal 10% solution CAS: 54-64-8	Preservative for dialysis equipment.		Immuno-adsorba	NB! A general ban on mercury is in effect, but chemicals for analysis may be sold until 31 December 2011.	Karolinska Universitetssjukhuset,
Stammopur DR 8	Detergent for colo / gastroscop and an ultrasound device for washing nipples for the scope	Toxic to aquatic life with long lasting effects. Suspected of damaging the fetus	Sekusept Multienzyme	Not hazardous, not even in higher concentrations	Region Halland, Hallands sjukhus,

Cleaning/disinfection

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Glutaraldehyde CAS:111-30-8	Disinfectant for instruments.		Solution with peracetic acid + hydrogen peroxide, e.g. Endodis		Akademiska sjukhuset

Other

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
Photo Mount	Mounting spray adhesive.	Contains isopentane, isoparaffin, etc.	Display Mount Adhesive 7806	Contain fewer hazardous substances.	Västra Götalandsregionen,
Hydrofluoric acid in pickling paste CAS 7664-39-3	Pickling paste is used to manually process stainless-steel welding joints in order to prevent corrosion.	Pickling paste typically contains both hydrofluoric acid and nitric acid.	Phosphoric acid-based solution	Substitution requires the purchase of an "electrolyte cleaning aggregate", in which a phosphoric-acid based solution is used. There are several different brands on the market.	Region Uppland
Ethanol 70% and lithium grease	Lubrication of wheel axles (e.g. blood trays and chairs)	Lithium grease contains e.g. heptane and cyclohexane	Baby oil (instead of ethanol) and white vaseline (instead of lithium grease)		Region Skåne, medical service (medicinsk service)