



*THE APPLICATION OF VIROFLOW™ TECHNOLOGY  
USING VIROBOND™ REAGENT FOR THE TREATMENT  
OF CCA CONTAMINATION*

**TECHNICAL PAPER**



*The ViroBond™ reagent application*

## INTRODUCTION

ViroFlow™ Technology, using ViroBond™ reagents, is suitable for treating:

- > CCA contaminated water bodies
- > CCA contaminated storm water
- > CCA contaminated soil
- > CCA contaminated sludge

## OVERVIEW

Throughout the world, evidence is mounting that the use of copper, chrome and arsenate (CCA) in the preservation of timber can pose a significant danger to human health and to the environment. As a result, regulatory authorities are imposing stricter control on its manufacture, use and disposal.

CCA is a well-established preservation technique that has been widely used in the developed world for several decades. Timber treated with CCA includes products for residential, commercial and recreational use. CCA-treated timber is usually identified by its light greenish tinge that tends to fade over time.

Copper (Cu) and arsenic (As) are used as fungicides and insecticides, while chromium (Cr) fixes these chemicals into the wood. As Beder (2003) explains, “the (CCA) chemical mixture is injected into the wood under pressure so that the wood is saturated with the chemicals. It prevents rotting, fungi, termites and marine organisms”.

The potential hazards of such treatment, along with posing a risk to timber workers, are linked to findings that As (a toxic element and known carcinogen) leaches out of timber over time and residues can be found on the surface of the wood.



*Leachate from stored timber is contaminated with heavy metals.*

Recently published reports show elevated concentrations of As in children exposed to CCA treated timber on or beneath play ground equipment. For example, it has been found that there is 76 mg/kg of As in soils below CCA-treated decking, and that this concentration increased to 138 mg/kg after eight years.

Several other studies have reported urinary arsenic concentrations in wood impregnation workers (Beder, 2003) that are up to ten times higher than arsenic concentrations in the general population. According to the U.S. Environmental Protection Agency (EPA), the amount and rate at which As leaches varies markedly from place to place as a result of factors such as climate, the acidity of rain and soil, the age of the wood products and the volumes of CCA applied.

Contamination of timber treatment sites where CCA is employed has long been recognised. However, according to the Scientific

Committee on Toxicity, Ecotoxicity and the Environment of the European Commission, "There is also evidence... that contamination of the soil and vegetation can extend to the area beyond the immediate boundaries of such sites, something that has been attributed to wind erosion, percolation, and surface drainage as well as on-site incineration of wood waste." Further data on the issues surrounding CCA and the environment are available from most environmental and regulatory authorities.

For these reasons, the use of CCA has been banned in some countries and may, after a recent U.S. initiative, be phased out in other countries for timber used in residential and recreational construction, although timber used in commercial construction will probably still be treated using CCA because of its cost-effectiveness (Greaves, 2003). Many countries already favour the use of CCB (copper-chrome-borate), which does not contain arsenic but still contains potentially environmentally hazardous copper and chromium, and other alternatives are being developed by the timber preservation industry.

ViroFlow™ Technology, provided by Virotec, has been developed specifically to remove copper, chromium and arsenic from leachate ponds and contaminated water bodies at timber preservation facilities. ViroFlow™ Technology can also be used for treating CCA contaminated soil, or hazardous sludge containing CCA.

**ViroFlow™ Technology currently represents the best available treatment strategy for CCA contaminated sites.** Management and control of the treatment process is based on Virotec's:

- > Extensive research database;
- > Practical experience with commercial scale applications; and,
- > Results of laboratory test-work for each water body or solid body to be treated.



*A leachate pond before treatment*



*The same pond after treatment using ViroBond™ reagent*

## VIROFLOW™ TECHNOLOGY APPLICATION

ViroFlow™ Technology incorporates the use of ViroBond™ reagent, a patented environmentally safe reagent that can be added directly to the leachate pond or contaminated water body or used as the active ingredient in flow-through treatment systems. When mixed with contaminated soil, ViroBond™ reagent will immobilise CCA permanently to allow safe disposal.

ViroFlow™ Technology is an innovative, new treatment strategy which results in treated water that meets the stringent National Environmental Protection Council Measures for Contaminated Sites (1999) Guidelines. ViroFlow™ Technology can be customised to suit any individual application, and the use of ViroFlow™ Technology requires little or no capital works.

The sediment formed when ViroBond™ reagent settles and dries is not a waste and has potential re-use applications. The sediment holds the bound CCA metals sufficiently tightly that they can neither be taken up by plants, nor released back into the water body. This property, combined with the high organic matter content of the solids, makes them potentially useful as a soil conditioner.

The major advantages of using ViroFlow™ Technology can be summarised as:

- > Significant reduction in copper, chromium and arsenic concentrations in treated water;
- > Metals are permanently bound in the solid residues;
- > Shorter settling times resulting in improved water quality;
- > Significant odour reduction;
- > Reduction in CCA concentration in stormwater runoff; and,
- > Re-classification of contaminated soil or hazardous sludge.

## CHEMISTRY OF VIROFLOW™ TECHNOLOGY

ViroBond™ reagent works by forming strong chemical bonds with the copper, chromium and arsenate ions in the leachate pond or water body. ViroBond™ effectively immobilises the metal into an insoluble, non-reactive sediment.

The heterogeneous mineral surfaces in ViroBond™ reagent catalyse metal precipitation from solution at a pH lower than that achievable with conventional alkaline treatments such as lime, sodium hydroxide and magnesium oxide by providing nucleating surfaces and acting as substrates for precipitation.

The primary mechanism for acid neutralisation and metal uptake in ViroBond™ reagent involves the dissolution of slightly soluble alkaline minerals that supply hydroxides and carbonate ions for the precipitation of very low solubility metal hydroxides, carbonates and hydroxy carbonate compounds on the product's surfaces.

The ability of ViroBond™ reagent to strip trace metals increases with time and because most metals bound by ViroBond™ reagent are held as structural components of low solubility minerals, they cannot be easily removed.

Many trace metals are initially trapped by adsorption that is exceptionally efficient because ViroBond™ is dominated by particles with a high surface area-to-volume ratio and a high charge-to-mass ratio. During aging, the elements are redistributed to become structural components of new low solubility minerals.

## ENVIRONMENT AND SAFETY

The use of ViroFlow™ Technology to treat CCA leachate ponds, stormwater drains and contaminated soil is both environmentally sustainable and economically viable. ViroBond™ reagent is environmentally safe and the exhausted material may be disposed as a non-leachable solid residue. Used ViroBond™ reagent is not a hazardous or prescribed waste material.

The leaching of used or spent ViroBond™ reagent cannot result in the release of any trace elements at potentially environmentally hazardous concentrations, and ViroBond™ reagent residue meets the requirements for classification as an inert solid based on the Australian NSW EPA TCLP test; similar, and commonly less stringent requirements, are applicable in most developed countries. However, Virotec International plc recommends checking local environmental regulations before disposal.

ViroBond™ reagent is classified as a non-hazardous substance for transport and is safe for unskilled workers to handle. ViroBond™ consists of minerals that are not known to pose any environmental hazard or human health risk.

## CASE STUDIES

Virotec has implemented CCA treatment solutions for many of Australia's largest CCA treatment plants. The following results were achieved with the use of ViroFlow™ Technology:

- > Cost-effective water treatment;
- > Compliance with discharge limits;
- > Potential for water re-use due to improved treated effluent quality;
- > Production of a stable residue sediment that is not classed as a hazardous waste;
- > Hazardous sludge re-classification; and,
- > Contaminated soil treatment.



ViroBond™ reagent can be applied as a slurry, powder or in pellet form depending on the application.

**TABLE 1: LARGE CCA TREATMENT PLANT**

Technical Data	Before Treatment	After Treatment with ViroFlow™ Technology	Discharge Limit (EPA)
Wastewater (L)	500,000	500,000	500,000
pH	6.8	7.9	6.5 - 8.5
Cu (mg/L)	0.142	0.01	1.0
Cr (mg/L)	0.498	0.06	0.5
As (mg/L)	0.124	0.009	0.05

**TABLE 2: Blayney Treated Pine; Australia – Leachate Pond**

Technical Data	Before Treatment	After Treatment with ViroFlow™ Technology	Discharge Limit (NEPC 1999)*
Wastewater (L)	2,000,000	2,000,000	2,000,000
pH	4.95	7.53	-
Cu (mg/L)	0.103	0.004	0.005
Cr (mg/L)	0.250	0.002	0.01
As (mg/L)	0.146	0.005	0.05

\* NEPC: National Environmental Protection Council, Australia.

The concentrations of all metals in the treated water in the Tables above are within the strictest limits for drinking water as specified by the Australian Drinking Water Guidelines.

**TABLE 3: Large CCA Treatment Plant – Treatment of CCA contaminated soil**

Technical Data	Before Treatment	After Treatment with ViroFlow™ Technology	Discharge Limit (NEPC 1999)*
As (mg/L)	24	3.1	5.0
Cr (mg/L)	4.8	0.03	5.0
Cu (mg/L)	100	0.479	10.0
Solid Volume		10 tonnes	

\* Department of Primary Industries, Water & Environment, Tasmania.

Contaminated soil from a large CCA treatment plant, previously classified as hazardous, was re-classified as a Level 3 contaminated soil.

**TABLE 4: ITI SAWMILLS, AUSTRALIA - TREATMENT OF CCA SLUDGE**

Technical Data	Solid Leachate After Treatment	NSW EPA Limit Solid Waste Classification
As (mg/L)	2.3	5.0
Total Cr (mg/L)	0.49	5.0
Cr VI (mg/L)	<0.05	5.0
Solids Volume	16 tonnes	-



*Leachate pond at Blaney's before treatment*



*The same pond, after treatment with ViroBond™ reagent*

## REFERENCES

Greaves, Harry. "The Australian timber industry and CCA-treated timber products". Timber Preservers Association of Australia, 2003.

Beder, Sharon. "Timber leachates prompt preservative review". Engineers Australia, June 2003, pp. 32-34.

New South Wales Environment Protection Authority. "Environmental compliance report: Wood preservation industry – Part A: Compliance Audit". Environment Protection Authority (EPA/56), June 2003.

New South Wales Environment Protection Authority. "Environmental compliance report: Wood Preservation Industry – Part B: Review of Best Practice and Regulation". Environment Protection Authority (EPA/57), June 2003.

Sludge from ITI Sawmills was treated using ViroBond™ reagent and subsequently disposed of as Solid Waste (NSW EPA Waste Classification).

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