

# Assessment of Biological, Chemical and Odour Removal Efficiency of the Naturopaths Choice MinWell+ Water Purifier System



Naturopaths Choice

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## 1.0 Introduction

This work has been designed to provide a preliminary assessment of the chemical and biological removal capacity of the Naturopaths Choice MinWell+ water purification system according to the AS/NZS 4348:1995 Water supply – Domestic type water treatment appliances – Performance requirements. For full compliance for chemical removal, AS/NZS 4348:1995 requires two filtration devices tested in parallel to achieve 66% or greater removal of a chemical from a challenge solution at five different points through the life of the treatment device (measured in the number of litres of potable water filtered through the device). For full compliance to the biological removal requirements for devices claiming anti-bacterial effects according to AS/NZS 4348:1995, 99.9999% (Log 6) of challenge organisms must be removed or rendered non-viable by treatment with the device. For devices not claiming any anti-microbial capacity, the standard requires that the device does not contribute to the microbial load of the treated water as assessed by heterotrophic plate count (HPC).

To provide a preliminary measure of compliance of the Naturopaths Choice MinWell+ system, chemical and biological challenge solutions were treated using the system and the removal efficiency of the device was assessed. Full compliance testing according to the standard requires multiple tests to be performed at various stages in the working life of the device being tested using replicate filtration devices. Though not fully compliant to the standard, the testing protocol used for this study provides an indication of the biological and chemical removal capacity of a new Naturopaths Choice MinWell+ system, providing some surety to end users that the system will meet the manufactures claims.



## 2.0 Methodology

A single Naturopaths Choice MinWell+ water treatment system was pre-conditioned for experimentation by filtering 10L of ultrapure type 1 water (resistivity  $\leq 18.2 \text{ m}\Omega \text{ cm}^{-1}$ ). The system was then dosed with 1 L of biological and chemical challenge solution in separate experiments. The filtration unit was flushed with 10L of ultrapure type 1 water between experiments.

The biological challenge solution was prepared using a 50 ml culture of a laboratory strain of *Escherichia coli* (strain DH5 $\alpha$ ) grown in nutrient broth overnight at 37°C. This was then added to 1L of sterile ultrapure water. The chemical challenge solution where prepared according to the recommendations outlined in ASNZS 4348 Table B1 (See Table 3b and 3 c for challenge solution constituents). Samples were collected before and after treatment for analysis of trace level contaminants in NATA accredited testing faculties. Table 1 outlines the methods used to analyse the samples.

**Table 1:** Analysis methods used in the study.

Analysis	Method Reference	Description
<i>E. coli</i> enumeration	APHA 9223	Most Probable Number (MPN) determination using Quanti-Tray.
pH	APHA 4500 H+	Direct measurement using pH probe.
Chlorine Free	GCCC 3.2.4	Colourmetric determination using spectrophotometry.
Fluoride (Total)	GCCC 6.11	Direct measurement using fluoride specific probe
Metals	GCCC 6.9	Quantification using ICP-OES
Organochlorine Pesticides	ALS EP068A	SPE concentration - GCMS quantification
Trihalomethanes	GCCC 2.5.6	SPME concentration – GCMS quantification

### 3.0 Results

Results are displayed in Table 3. Concentrations for compliance to removal requirements according to AS/NZS 4348 are displayed. The data reported here is only a preliminary assessment for control and removal capacity for odour, chemicals and biologicals of the Naturopaths Choice MinWell+ water purification system. Full removal capacity testing throughout the life of the filter **WAS NOT** performed in accordance to AS/NZS 4348: 1995 (Appendix A6: Microbiological Test – Point of use (POU) appliances including stand-alone appliances; Appendix B: Chemical reduction and filter life test) therefore these results **DO NOT** indicate the Naturopaths Choice MinWell+ water purifier is compliant to the standard. All testing was performed on one new filtration unit using a single dosing trial, so are therefore the results can only be considered as indicative of filter performance under the testing conditions used for the study.

**3.1 Free Chlorine and Odour Control:** Table 1 is annotated directly from AS/NZS 4348: 1995 Section 5.2 and outlines the classifications for different grades of free chlorine removal. The results for the chemical removal capacity in Table 3 c. The MinWell+ water filter met the requirements for Class 1 status for removal of free chlorine (>75% removal), removing greater than 99.8% of the free chlorine in the challenge solution.

**Table 2:** Requirements for chlorine removal classification stipulated in AS/NZS 4348: 1995 Section 5.2

Class	Chlorine removal
I	75% or greater
II	50% - 75%
III	25% - 50%

**3.2 Biological Removal Capacity:** For full anti-microbial activity according to AS/NZS 4348: 1995 (Appendix A: Microbiological Testing) the device must achieve a log 6 (99.9999%) removal of a challenge bacterial organism. In this case a laboratory strain of *Escherichia coli* (strain ATCC 15766) was used as a challenge organism. The results of the challenge experiment are displayed in Table 3b. The MinWell+ achieved compliant challenge organism removal rates, with reductions in the spiked *E.coli* cells exceeding the 1 million fold requirement.

**3.3 Chemical Removal Capacity:** The results of the chemical analysis are displayed in Table 3c. The guidelines in ASNZS 4348: 1995 (Section 3.2) for chemical removal require at least 66% removal after treatment. The MinWell+ achieved successful chemical removal for all the organic and inorganic chemicals tested except for fluoride. Greater than 90% removal was observed in removal of all the challenge organics compounds, except the trihalomethanes were 75.3% of the challenge solution chloroform was removed post filtration.

**Table 3a:** Physical Testing Results.

Parameter	Pre-Filtration	Post-Filtration	Limit of Reporting
pH	6.9	9.2	0.03

**Table 3b:** Biological Testing Results.

Parameter	Pre-filtration	Post-filtration	Compliant Removal Concentration	Units	Limits of Reporting
Escherichia coli	2,400,000	< 2	2.4	CFU/ 100 mL	1

**Table 3c: Chemical Testing Results.**

Parameter	Pre-filtration	Post-filtration	Compliant Removal Concentration	Percent removal	Units	Limits of Reporting
<b>Halides</b>						
Free Chlorine	6.8	N/D	1.7	>99.8%	mg/L	0.05
Fluoride (Total)	9.6	3.5	3.1	63.6%	mg/L	0.1
<b>Metals</b>						
Aluminium (Total)	3.5	0.01	1.1	99.7%	mg/L	0.005
Copper (Total)	3.2	N/D	1	>99.9%	mg/L	0.005
Silicon	2.8	1.5	0.9	46.5%	mg/L	0.1
Iron (Total)	3.0	N/D	1	>99.7%	mg/L	0.01
Zinc (Total)	28.5	N/D	9.4	>99.9%	mg/L	0.01
Lead (Total)	3.0	N/D	1	>99.9%	mg/L	0.005
Calcium (Total)	33.8	9.6	11.2	71.6%	mg/L	1
Potassium (Total)	33.7	3.1	11.1	91.1%	mg/L	0.5
Magnesium (Total)	33.4	19.7	11	41.1%	mg/L	0.5
<b>Hormones</b>						
Estrone	772	ND	254	>99.1%	µg/L	7
Estriol	699	ND	230	>99%	µg/L	7
Estradiol	746	ND	246	>99.1%	µg/L	7
Trenbolone	113	ND	37	>95.9%	µg/L	7
Testosterone	228	ND	75	>97%	µg/L	7
Testosterone propionate	438	ND	144	>98.5%	µg/L	7
<b>Pharmaceuticals and Personal Care Products</b>						
Acetaminophen (paracetamol)	230	ND	75	>97%	µg/L	7
Caffeine	26	ND	8	>74.1%	µg/L	7
Diltiazem	129	ND	42	>94.8%	µg/L	7
Carbamazepine	213	ND	70	>96.8%	µg/L	7
Diazepam	106	ND	35	>93.4%	µg/L	7
<b>Pesticides</b>						
Glyphosate	500	25.5	165	94.8%	µg/L	7
Aminocarb	100	ND	33	>93%	µg/L	7
Atrazine	100	ND	33	>93%	µg/L	7
Carbofuran	100	ND	33	>93%	µg/L	7
Diazinon	100	ND	33	>93%	µg/L	7
Imazalil	100	ND	33	>93%	µg/L	7
Imazapyr	100	ND	33	>93%	µg/L	7
Metazachlor	100	ND	33	>93%	µg/L	7
Metosulam	100	ND	33	>93%	µg/L	7
Metoxuron	100	ND	33	>93%	µg/L	7
Pyraclostrobin	100	ND	33	>93%	µg/L	7
Thiabendazole	100	ND	33	>93%	µg/L	7
<b>Trihalomethanes (THMs)</b>						
Chloroform	1.82	0.45	0.6	75.3%	mg/L	0.005

**Colour Coding Key****Passes** removal requirements under ASNZS 4348 according to preliminary testing.**Fails** removal requirements under ASNZS 4348 according to preliminary testing.

## 4.0 Direct filtration of tap water

Parameter	Pre-filtration	Post-filtration	Units	Limits of Reporting
Aluminium	0.03	0.02	mg/L	
Copper	0.225	0.04	mg/L	
Silicon	4.734	4.60	mg/L	
Iron	ND	ND	mg/L	
Zinc	0.104	0.027	mg/L	
Lead	ND	ND	mg/L	
Calcium	13.89	13.72	mg/L	
Sodium	17.21	18.09	mg/L	
Potassium	1.93	2.09	mg/L	
Magnesium	3.81	7.37	mg/L	
Chromium	ND	ND	mg/L	
Silver	ND	ND	mg/L	
Cobalt	ND	ND	mg/L	
Cadmium	ND	ND	mg/L	
Manganese	ND	ND	mg/L	
Nickel	ND	ND	mg/L	
Molybdenum	ND	ND	mg/L	
Tin	ND	ND	mg/L	
Selenium	ND	ND	mg/L	
Platinum	ND	ND	mg/L	
Arsenic	ND	ND	mg/L	
Mercury	ND	ND	mg/L	

## 5.0 References

**ASNZS 4348: 1995 Water supply – Domestic type water treatment appliances – Performance requirements**

