



COMPARISON OF METRICIDE OPA PLUS™ SOLUTION AND CIDEX® OPA SOLUTION USE PROPERTIES

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Comparison of MetriCide OPA Plus Solution and Cidex OPA Solution Use Properties

ABSTRACT

The properties of MetriCide OPA Plus Solution, a high-level disinfecting solution, are compared to Cidex OPA Solution with regards to composition, reuse stability and reuse costs in a legally marketed automated endoscope reprocessor (AER) system, use stability, safety, efficacy and materials compatibility.

MetriCide OPA Plus Solution has comparable composition and properties to Cidex OPA Solution. MetriCide OPA Plus Solution is manufactured with a slightly higher active ingredient content, while meeting the same stability, safety, efficacy, and materials compatibility as Cidex OPA Solution. The increase in OPA content enhances its ability to achieve more equipment treatments over a 14-day use period, resulting in substantial cost savings for medical facilities. Under comparable reuse conditions conducted at an independent contract laboratory, using Custom Ultrasonics System 83 Plus 2 AERs, MetriCide OPA Plus Solution achieved 32 more treatment cycles than Cidex OPA Solution as indicated by their respective concentration monitoring test strips. The increased number of disinfection cycles with MetriCide OPA Plus Solution translates to at least a 40% reduction in cost, assuming comparable product cost.

INTRODUCTION

Development of the Cidex OPA Solution¹ began in 1986 at SurgiKos, Inc., a Johnson & Johnson Company, to provide health care professionals with an alternative to glutaraldehyde based high-level disinfecting solution products. This patented technology² does not require activation or dilution, exhibits less irritation to eyes and mucous membranes than glutaraldehyde-based products, and when used in an AER system, high-level disinfects in 5 minutes at 25°C up to a maximum of 14 days or until its effectiveness is contraindicated as shown by the Cidex OPA Solution test strip.

In May 2007, Cidex OPA Solution patents expired allowing less costly competitive OPA products to become available to health care professionals. This paper reports on a new OPA product, MetriCide OPA Plus Solution³, with use stability, safety, efficacy and materials compatibility properties at least equivalent to Cidex OPA Solution. However, MetriCide OPA Plus Solution is less expensive than Cidex OPA Solution and contains more active ingredient, resulting in its ability to achieve an increase in equipment treatments.

COMPARATIVE CHEMISTRY

MetriCide OPA Plus Solution and Cidex OPA Solution are stable, one-component ready-to-use high-level disinfectants. The active ingredient in both solutions is *ortho*-phthalaldehyde (OPA), an aromatic dialdehyde (Figure 1). In addition to OPA, both products contain phosphate buffering salts, a corrosion inhibitor, chelating agents, a dye and water (Table 1). MetriCide OPA Plus Solution contains 0.05% more OPA than Cidex OPA Solution; thereby enhancing its ability, to achieve an increase in equipment treatments during the recommended 14-day use period, especially in large volume endoscopy centers. Both products exhibit excellent stability, antimicrobial activity, materials compatibility and rinsing properties throughout their use life. Shown below are the respective ingredients listed on each product's label.

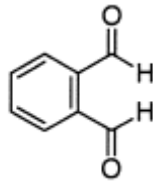


Figure 1: Chemical Structure of *ortho*-phthalaldehyde (OPA)

Table 1: Comparison of Ingredients and Concentrations in MetriCide OPA Plus Solution and Cidex OPA

	MetriCide OPA Plus Solution	Cidex OPA Solution
Active Ingredient (OPA)	0.60%	0.55%
Inert Ingredients	99.40%	99.45%
Water		
Dipotassium hydrogen phosphate		
Potassium dihydrogen phosphate		
Benzotriazole		
Citric acid		
Dye: D&C Green #5		
N-(hydroxyethyl)-ethylenediaminetriacetic acid (HEDTA)		
Total:	100.00%	100.00%

REUSE STABILITY

The use life of both MetriCide OPA Plus Solution and Cidex OPA Solution were compared in Custom Ultrasonics System 83 Plus 2 Automated Endoscope Reprocessors (AER). Test conditions followed a modification of the EPA “Reuse Test Protocol Specification.” This comparative study was performed at MicroBiotest, Inc., Sterling, VA. Both solutions were tested over a 14-day period. Seven reprocessing cycles were run per day for ten days and four cycles on the eleventh operating day. Each cycle was run at a solution temperature of 25±2°C. During the remaining three days, the AER sat idle with the temperature of the test solutions maintained at 25±2°C. Each cycle was run with Pentax and Olympus endoscopes in the AER equipment basin. At the beginning of each day’s operation, a bioburden organic load was added to the AER basin.

The OPA solutions were monitored regularly during the 14-day reuse period using each product’s test strip. MetriCide OPA Plus Solution Test Strips (exp. date: 08/2008) and Cidex OPA Solution Test Strips (exp. date: 02/2008) were used with their respective disinfecting solution products. MetriCide OPA Plus Solution achieved 74 cycles during the reuse period, while Cidex OPA Solution achieved only 42 cycles under similar test conditions. Solution failure was indicated by the MetriCide OPA Plus Solution Test Strip with an incomplete color change from yellow to magenta or the test strip remaining yellow and the Cidex OPA Solution Test Strip with an incomplete color change to purple or the test strip remaining blue. Reuse test results are presented in Table 2 and summarized in Figure 2.

Table 2: Summary of Test Strip Evaluation Determinations

Day	Cycle No.	MetriCide OPA Plus Solution		Cidex OPA	
		Color	Result	Color	Result
Pre-Day 1	0	Magenta	Pass	Purple	Pass
Post-Day 1	Post-cycle 7	Magenta	Pass	Purple	Pass
Post-Day 2	Post-cycle 14	Magenta	Pass	Purple	Pass
Post-Day 3	Post-cycle 21	Magenta	Pass	Purple	Pass
Post-Day 4	Post-cycle 28	Magenta	Pass	Purple	Pass
Post-Day 5	Post-cycle 35	Magenta	Pass	Purple	Pass
Post-Day 8	Post-cycle 42	Magenta	Pass	Blue	Fail
Post-Day 9	Post-cycle 49	Magenta	Pass	Blue	Fail
Post-Day 10	Post-cycle 56	Magenta	Pass	Blue	Fail
Post-Day 11	Post-cycle 63	Magenta	Pass	Blue	Fail
Post-Day 12	Post-cycle 70	Magenta	Pass	Blue	Fail
Day 13	Post-cycle 71	Magenta	Pass	Not applicable	
Day 13	Post-cycle 72	Magenta	Pass	Not applicable	
Day 13	Post-cycle 73	Magenta	Pass	Not applicable	
Day 13	Post-cycle 74	Yellow	Fail	Not applicable	
Post-Day 14	Confirmatory*	Yellow	Fail	Blue	Fail

*Cidex OPA, Lot No. 131106614 (exp. 11/2008), was only tested through 70 cycles; MetriCide OPA Plus, Lot No. 180785 (exp. 8/2009), was tested through 74 cycles.

Comparison of MetriCide OPA Plus Solution and Cidex OPA Reuse Life

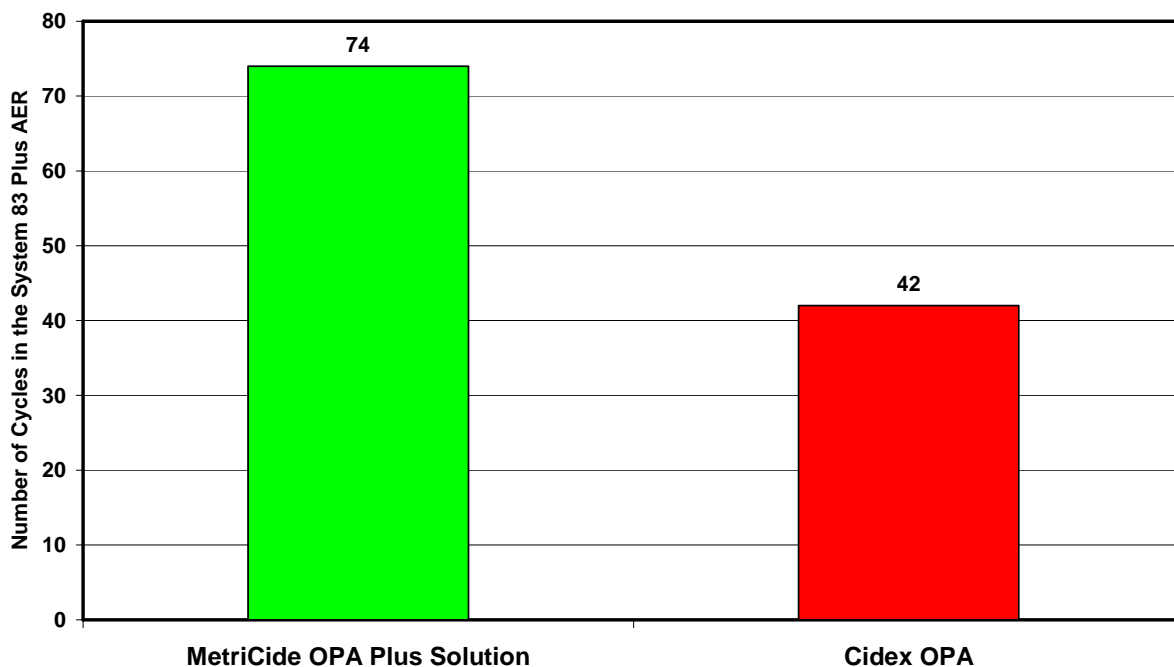


Figure 2: Results of the Reuse Stability Comparison between MetriCide OPA Plus Solution and Cidex OPA. The MetriCide OPA Solution Test Strips indicated that the MetriCide OPA Plus Solution should be discarded after the 74th cycle. In contrast, the Cidex OPA Test Strips indicated that the Cidex OPA solution should be discarded after the 42nd cycle.

REUSE COSTS

Based on the increased number of disinfection cycles achieved with MetriCide OPA Plus Solution in the System 83 Plus AER versus Cidex OPA Solution, health care facilities should realize a significant cost savings using MetriCide OPA Plus Solution. For purposes of this comparison, a catalogue price of \$54.79 per gallon will be used for both products.⁴ The reuse costs per cycle for each solution used in several sized basins were determined using the following equation and shown in Table 3:

$$(\text{Cost per gallon}) \times (\text{Number of gallons in AER basin}) \div \text{Number of cycles} = \text{Cost (\$) per cycle}$$

This cost comparison chart does not reflect discount pricing, nor does it include the cost of solution monitoring with test strips. Assuming comparable product pricing, MetriCide OPA Plus Solution will result in lower costs per use due to the projected increased number of cycles.

Table 3: Summary of Reuse Costs (\$) per Cycle based on AER Basin Capacity

Disinfection Cycles ^a	8-Gallon Basin		6-Gallon Basin		4-Gallon Basin	
	MetriCide OPA Plus	Cidex OPA	MetriCide OPA Plus	Cidex OPA	MetriCide OPA Plus	Cidex OPA
74	\$5.92	N/A ^b	\$4.44	N/A	\$2.96	N/A
70	\$6.26	N/A	\$4.70	N/A	\$3.13	N/A
42	N/A	\$10.44	N/A	\$7.83	N/A	\$5.22

a. Number of equipment treatment cycles during a 14-day maximum reuse period.

b. N/A – Not applicable.

TEST STRIP

The MetriCide OPA Plus™ Solution Test Strip was developed to indicate when the minimum recommended concentration (MRC) of OPA in MetriCide OPA Plus Solution has been reached during the reuse process in AER systems. This end point is clearly indicated by a change in test strip color from yellow to magenta. MRC is used by the FDA to replace minimum effective concentration (MEC) terminology. Use of a concentration monitoring test strip is recommended before each processing cycle to ensure health care professionals that the disinfectant has not been compromised by excessive reuse, contamination attributed to inadequate equipment cleaning, AER malfunction causing excessive dilution, or misuse of the product.

Features of the MetriCide OPA Plus Solution Test Strip include:

- Test results in 60 seconds (33% faster than the Cidex OPA Solution test strip).
- Easy interpretation of pass/fail test results when compared to color blocks located on the MetriCide OPA Plus Solution Test Strip bottle.
- More test strips for same price – 100 test strips per bottle as opposed to product configurations offered by Cidex OPA (15 or 60 test strips per bottle).

USE STABILITY

Use (opened bottle) stability of a disinfecting solution is defined by its ability to remain unchanged once its container has been opened and solution is periodically removed from its original package over a designated period of time. The use stability of MetriCide OPA Plus Solution was shown to be at least 75 days. Over a 75-day test period, the OPA content, pH and solution appearance (insolubles and discoloration) of three lots of MetriCide OPA Plus Solution remained relatively unchanged. OPA content increased slightly over the 75-day test period due to water evaporation from the solution. Test results are shown in Table 4.

Table 4: Summary of Use Stability for 3 Lots of MetriCide OPA Plus Solution at 25±2°C

Test Time (days)	MetriCide OPA Plus Solution								
	Lot A			Lot B			Lot C		
	OPA (%)	pH	Appearance	OPA (%)	pH	Appearance	OPA (%)	pH	Appearance
Initial	0.64	7.5	Pass	0.66	7.5	Pass	0.63	7.4	Pass
30	0.66	7.5	Pass	0.69	7.5	Pass	0.64	7.4	Pass
75	0.67	7.5	Pass	0.71	7.4	Pass	0.65	7.4	Pass

SAFETY

Cidex OPA Solution was first introduced for sale as a high-level disinfecting solution in November, 1999. Over the years, Cidex OPA Solution has become widely accepted by health care professionals because of its ease of use, reduced odor and irritation properties, proven safety and effectiveness and excellent materials compatibility properties. Table 5 compares the biocompatibility properties of MetriCide OPA Plus Solution with Cidex OPA Solution. Test results point out the equivalent safety of these products.

Table 5: Summary of Biocompatibility Tests

Study (Species)	Purpose	Results	
		MetriCide OPA Plus	Cidex OPA ⁵
Acute oral LD ₅₀ (rat)	Determine the hazard associated with an acute (one time) oral dose of the product.	LD ₅₀ > 5000 mg/kg	LD ₅₀ > 5000 mg/kg
Acute dermal LD ₅₀ (rabbit)	Determine the hazard associated with an acute dermal dose of the product.	LD ₅₀ > 2000 mg/kg	LD ₅₀ > 2000 mg/kg
Primary eye irritation (rabbit)	Determine ability of product to cause eye irritation	Moderate irritant	Moderate irritant
Primary dermal irritation (rabbit)	Determine ability of product to cause skin irritation	Full strength: Moderate irritant Other: Not tested	Full strength: Not tested Other: Non-irritating
Skin sensitization (guinea pig)	Determine ability of product to cause skin sensitization.	Non-sensitizing	Non-sensitizer
Acute inhalation (rat)	Determine the hazard associated with an exposure to product vapors.	No data	No data
Cytotoxicity – MEM elution	Determine the hazard associated with residuals from the product.	Non-cytotoxic (MD1 System)	No data available
Hemocompatibility	Determine the hazard associated with residuals of the product	Extracts non-hemolytic	No data available

EFFICACY

A comparison of the efficacy test results for MetriCide OPA Plus Solution and Cidex OPA Solution are shown in Table 6. Both solutions were tested in accordance with guidelines established by the Environmental Protection Agency (EPA) for reuse in AER systems. For those tests common to both products, equivalent efficacy was observed. MetriCide OPA Plus Solution was tested against viruses representative of the categories required by the FDA, in addition to other viruses that pose a threat today or are representative of viruses that can jeopardize the well-being of health care professionals. These viruses include: Hepatitis A and B and the Avian Influenza A.

Table 6: Summary of Efficacy Testing

Potency Tests	Purpose	Results at 25°C (AER)	
		MetriCide OPA Plus	Cidex OPA ⁶
Bactericidal, Fungicidal, Tuberculocidal and Sporocidal Tests AOAC Use Dilution AOAC Fungicidal Quantitative TB (rate-of-kill) AOAC Sporocidal Confirmatory AOAC Sporocidal	Bactericidal activity Fungicidal activity Tuberculocidal activity Sporocidal activity Confirm sporocidal activity at second lab	Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; ≤32 hr (20°C and 25°C) Passed; ≤32 hr (20°C and 25°C)	Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; ≤32 hr (20°C and 25°C) Passed; ≤32 hr (20°C and 25°C)
Virucidal Tests <i>Non-Enveloped Viruses</i> Poliovirus type 1 Rhinovirus type 42 Adenovirus type 2 Vaccinia (Wyeth) Coxsackievirus type B-3 Hepatitis A <i>Enveloped Viruses</i> Coronavirus Cytomegalovirus Influenza Virus (Hong Kong) Human Immunodeficiency Virus 1 (HIV-1) Herpes Simplex-1 Herpes Simplex-2 Duck Hepatitis B Avian Influenza A	Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity Virucidal activity	Passed; 5 min. Passed; 5 min. Not tested Not tested Not tested Passed; 5 min. Not tested Not tested Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Not tested Passed; 5 min. Passed; 5 min.	Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min. Passed; 5 min.
Simulated Use Test Endoscopes inoculated with <i>M. terrae</i>	Confirm disinfection	Passed; 5 min.	Passed; 5 min.
In-Use Test Clinical Setting	Confirm disinfection in a clinical setting	Passed; 5 min.	Passed; 5 min.

MATERIALS COMPATIBILITY

MetriCide OPA Plus Solution was tested and found to be compatible with the materials shown below. Materials were exposed to 31 days (744 hours) of continuous contact with MetriCide OPA Plus Solution with no effect unless otherwise noted. These results are consistent with test results reported for Cidex OPA.⁶ Note: According to the Cidex OPA Instructions-For-Use sheet, materials compatibility testing of plastics, elastomers and adhesives were only tested for 7 days of continuous contact with Cidex OPA. These materials are representative of materials used in the fabrication of medical and dental equipment.

Metals	Plastics
Aluminum (Al)	Polymethylmethacrylate (Acrylate)
Anodized Al	Nylon ^a
Brass	Polyethylene terephthalate (Polyester)
Carbon steel	Polystyrene
Chrome plated brass	Polyvinylchloride (PVC)
Chrome plated steel ^a	Acrylonitrile/butadiene/styrene (ABS)
Copper	Polysulfone
Nickel plated brass	Polycarbonate
Nickel silver alloy	Polyethylene
Stainless steel ^b	Polypropylene
Titanium	Acetal
Tungsten carbide ^a	Teflon [®] (PTFE)
	Polyamide

Elastomers	Adhesives
Polychloroprene (Neoprene)	EPO-TEK 301 Epoxy ^c
Kraton G ^a	EPO-TEK 353 Epoxy
Polyurethane	
Silicone rubber	
Natural rubber latex ^a	

a. After 31 days, some discoloration was observed

b. After 31 days, stainless steel 304 showed slight discoloration and some corrosion

c. After 31 days, degradation and discoloration observed

ENDOSCOPE COMPATIBILITY

MetriCide OPA Plus Solution was evaluated for its effect on appearance, functionality and compatibility with Olympus and Pentax endoscopes used in medical facilities in AER systems that can be set to 25°C. Endoscope compatibility studies with MetriCide OPA Plus Solution were conducted in laboratory settings in simulated-use tests using a Custom Ultrasonics System 83 Plus 2 and in clinical settings using Medivators SSD-102 AER. No changes to the appearance or function were observed.

DISCUSSION

MetriCide OPA Plus Solution, a new OPA disinfecting solution, has a composition comparable to Cidex OPA Solution. MetriCide OPA Plus Solution demonstrates safety, efficacy, and materials compatibility properties also comparable to Cidex OPA Solution. The unique feature of MetriCide OPA Plus Solution lies in the meaning of the “Plus”, which appears in its name. MetriCide OPA Plus Solution contains 0.05% more OPA than found in Cidex OPA.

MetriCide OPA Plus Solution produced 32 additional disinfection cycles (40% more) in the Custom Ultrasonics System 83 Plus 2, than achieved with Cidex OPA Solution under similar test conditions.

MetriCide OPA Plus Solution Test Strips offer significant advantages over that of the Cidex OPA Solution Test Strips. These advantages include:

- 33% faster test results than the Cidex OPA Solution Test Strips.
- Easy interpretation of pass/fail test results when compared to color blocks located on the MetriCide OPA Plus Test Strip bottle.
- MetriCide OPA Solution Test Strips are more conveniently packaged in 100 test strips per bottle to enhance test strip availability.

Table 7 summarizes the features and benefits of MetriCide OPA Plus vs. Cidex OPA.

Table 7: Features and Benefits Comparison for MetriCide OPA Plus and Cidex OPA

Feature	MetriCide OPA Plus	Cidex OPA	Benefit(s)
0.60% Concentration of Active Ingredient (OPA)	X		Increased Number of AER Cycles
			Reduced Cost
One Component Package	X	X	No Activation Required
			No Dilution Required
High-Level Disinfectant ^a (Including Viruses)	X	X	Manual Processing 20°C for 12 Minutes
			AER Processing 25°C for 5 Minutes
Materials Compatibility	X	X	Safe for Metal, Rubber and Plastic Equipment
Endoscope Compatibility	X	X	Compatible with Endoscopes
14-day Reusability	X	X	MetriCide OPA Plus Solution is Substantially Equivalent to Cidex OPA
Test Strips Read in 60 Seconds	X		Improves Operator's Efficiency ^b

a. Sporicidal activity demonstrated for high-level disinfection.

b. MetriCide OPA Plus Solution test strip produces a test result 33% faster than the Cidex OPA Solution test strip.

CONCLUSION

MetriCide OPA Plus Solution is a new OPA high-level disinfecting solution with excellent safety, efficacy and materials compatibility properties. The added active ingredient content in MetriCide OPA Plus Solution enhances the product's use life in AER systems (within the stated 14-day reuse period), resulting in lower endoscope reprocessing costs for health care facilities.

REFERENCES

- ¹ Insights, a publication for employees of Surgikos, Inc., October/November 1989
- ² US Patents: 4,847,304; 4,851,449 and 4,971,999
- ³ Metrex Research Corporation, 1717 West Collins Avenue, Orange, CA 92867
- ⁴ Henry Schein product catalogue; August 2007
- ⁵ Cidex OPA Solution MSDS
- ⁶ Cidex OPA Solution product label and packaging insert

