WHIFFS
SURVIVAL GEAR FOR YOUR LUNGS

Xcaper® Civilian Smoke Mask Overview:

The Xcaper® filter is the world's first moist direct-contact smoke mask. It uses patented technology combining a natural-based aloe gel extract and negatively charged styrene beads to attract and neutralize 99% of all water-soluble gases and 94% of dust and particulate matter down to about 2 microns. The Xcaper® technology is lab-verified, approved for use by the US Navy for purchase and has been proven in tens of thousands of live fire situations over the last several years by nearly 50,000 professional firefighters.

The unique features of this smoke mask provide it with unsurpassed ease-of-use, comfort and breathe-ability, portability and protection. In addition to unparalleled protection, Key Features and Benefits include:

Ease of Use: Panic-Proof Design	Absolutely panic-proof – cannot be used incorrectly. Donning or holding a mask up to one's face is a natural reaction that requires no training. Conventional design means high user acceptance.
High Perceived Protection Value	Widespread use and acceptance of Xcaper® filter among firefighters gives users tremendous confidence in the product, which delivers the important tangible benefit of perception of increased safety.
Ease of Deployment Across Large Organizations	Because the unit requires NO TRAINING, Xcaper® masks can be pre-positioned near emergency exits on each floor, or as a part of a new or existing emergency kit. No training means low total deployment cost.
Long Protection Period	The professional unit is frequently worn for 8-12 hours at a time. The ultra-conservative rating for the civilian version is 45 minutes or more depending on conditions.
Allows Full Vision & Communication	Users retain ability to speak, vision and hearing is unobstructed. Optional goggles are non-fogging with excellent peripheral vision.
Lightweight and Compact	At 2.2 oz, it is practical to carry this unit while traveling or commuting, or to have on one's person during high alert periods.
Suitable for All Abilities and Ages	Very low breathing resistance fits all face shapes, sizes, and facial hair. Can be used by children to elderly, no medical constraints other than those stated on the filter foil packaging.
Realistic Protection That is Cost Effective	Smoke, gases, and airborne dust and debris as the result of fire or the aftermath of an explosion – whether accidental or intentional – is the most likely type of emergency that a person will face. The Xcaper® provides critical respiratory protection that is essential to employee's perceived safety, without budget-breaking costs.

SUMMARY OF CONTENTS OF REPORTS

1. REFERENCES:

Xcaper Industries is proud to have nearly 40,000 firefighters in the USA using its professional Xcaper filter and Whiffs masks in just 2 ½ years in the market with this new moist filter technology. The people on the reference sheet represent small and large fire departments. Many have been using our professional product since the Xcaper professional filter came into the market in 2000. Hundreds of additional references are available by state upon request.

2. U.S NAVY SAFETY AND SURVIVABILITY OFFICE REPORT:

The Navy tested the Xcaper Civilian Smoke Mask at an independent facility (QuaDelta Inc.) and found that the filter performed as the manufacturer specified and recommended it for use by Navy Shore Facilities and DOD office environments.

3. TRUESDALE LABORATORY TESTS:

These lab tests were performed by the same company that the California Air Quality Monitoring Department uses to perform their test. These lab tests show the ability of the Xcaper filter to filter Hydrogen Cyanide, Hydrochloric acid, Acrolein, and particulate matter.

	Filtering Level
Hydrogen Cyanide	93.6%
Hydrochloric Acid	99.7%
Acrolein	99.8%
Particulate Matter	94.1%

The above gases are water-soluble gases. The Xcaper filter will filter all water-soluble gases, known as "Anhydrite" gases in the 90%+ range. Note: The amount of cyanide used in Truesdale's test was 360 parts per million which is extremely dangerous with 15 minutes of exposure. The amount of cyanide normally found in structure fires is around 1-9 parts per million.

4. & 4A FILTERING OF DIOXINS – NOVASCREEN (4) & WMD PREPAREDNESS SRV.,INC (4A):

These letters are in response to Xcaper Industries request to evaluate the Xcaper filter's ability to remove dioxins, furans and Polychlorinated Biphenyls's (PCB's) that are created as a by-product of combustion. The conclusion of these reports is that the Xcaper filter absorbs dioxins and significantly reduces the temperature of hot gases.

WHIFFS
SURVIVAL GEAR FOR YOUR LUNGS

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5. MEDICAL REPORTS BY MISSION HOSPITAL:

A.) The "**Airflow Efficiency Testing**" report concludes that the Xcaper® filter can be used during stressful working conditions without a significant increase in the user's heart rate. Additionally, this test showed that the wearer of the Xcaper filter had a considerably lower heart rate than the heart rate of the wearer who performed the same test wearing an N95 filter with an exhalation valve (these type filters were used at ground zero and caused many breathing problems for the firefighters).

B.) The "**Carbon Dioxide Testing and Airflow Efficiency**" report concludes that there is no significant retention of carbon dioxide from breathing directly into the Xcaper filter during exercise. The work of breathing and oxygen consumption were essentially unchanged with use of the Xcaper filter.

6. PROFESSIONAL REPORTS ON HOW AND WHY THE FILTER WORKS:

A.) This report discusses the operation of the Xcaper smoke filter and how it compares to other air purifying filters of different construction. The report concludes that the filter is effective on a wide range of substances and actually becomes more efficient with use, as the trapped contaminants act to further obstruct the path of new ones. Air passageways remain relatively free of obstruction since the filter acts primarily by adsorbing contaminants onto electrochemically active surfaces, this process continues unabated during use.

B.) This report discusses the micro scale physical/chemical mechanisms responsible for the observed performance of the Xcaper smoke filter. This report concludes that the processes of adsorption, aerosol formation and coagulation found in fires along with the added effects of absorption interference and solvent-induced dissociation are also important in accounting for the observed performance of the Xcaper® filter

7. NAVY COASTAL SYSTEMS STATION – OFFGAS ANALYSIS OF THE XCAPER FILTER:

All products are given a heat test to show what gases are emitted when the product is subjected to chamber with 180 psig with high purity (zero) air and a temperature of 160° for 4 hours before an analysis for specific and total hydrocarbons. In all categories, the Xcaper filters tested significantly under the permissible exposure limits specified by OSHA.

8. DISCUSSION OF CARBON MONOXIDE (CO)

Many people believe or have heard that CO is a significant problem in a fire. The reality is that most people who are affected by the results of the fire (smoke and toxins) are never exposed to high levels of CO. Results from a study supported by the City of Phoenix Fire Dept. and performed by the University of Arizona and the Phoenix FD shows that CO levels on 25 surveyed fires averaged 52.6 parts per million. This is 2.6 parts per million above the permissible Exposure level for 8 hours (OSHA standard). See Table III in the report section. According to the chart provided by the Peabody Fire Department in Massachusetts, a person can be exposed to 200 parts per million and will possibly have a mild frontal headache in 2-3 hours. Most people must exit the building in 20-30 minutes after the emergency takes place. Chart included in summary reports.

9. BIO-CHEM EFFECTIVENESS

Xcaper filters are not represented as 'bio-chem gas masks', and just as with all other respiratory protective devices, in the absence of head-to-toe protection, proper training, sufficient notification prior to potential exposure and decontamination stations to allow safe removal of protective equipment, they cannot be considered to offer any effective level of bio-chem protection.

Protection against military-grade threats is exceedingly difficult for even highly trained and equipped military personnel, and is a practical impossibility for large civilian populations.

Xcaper filters and goggles provide excellent and practical respiratory and ocular protection against anhydrite gases, such as hydrogen cyanide, PCBs, Dioxins, and all airborne smoke, dust and debris particles, regardless of the whether the source of the material is a wildland fire, structural fire or explosion, whether accidental or intentional. Consequently, the Xcaper system is focused on providing an advanced level of respiratory and ocular protection against the most likely threat scenarios that can be realistically addressed. NOTE: NO NUMBERED REPORT FOR THIS CATEGORY.

10. A CHEMICAL ENGINEERS ENDORSEMENT OF THE XCAPER FILTER'S CAPABILITIES

This letter describes the characteristics of the filter as to it near perfect fit on any wearer without fit testing, analyzes the components (Aloe Vera gel , polystyrene beads) and their relationship to each other and how they filter smoke and dissolve gases, both water soluble and non-water soluble.

References

Keith Hackbarth	BLM Strike Team Leader, ID	775-761-5953
Bob Kienas	Somers Vol. FD, MT	406-253-0803
Tim Kowallek	City of San Diego, CA	858-573-1383
Mike Hogan	San Luis Obispbo FD, CA	805-781-7380
Gordon O'Neill	Santa Barbara Co. FD, CA	805-686-4606
Eric Wells	Rancho Cucamonga FD, CA	909-919-2920
Jim Stocking	Montebello FD, CA	915-784-6050
Al Schmehl	Newport Beach Fire CA *	949-644-3114
Donna Reed	Ventura County FD, CA	805-987-5928
Michelle Wagner	Palo Alto FD, CA	650-329-2423
Debbie Mart	Sacramento City FD, CA	916-729-2019
Victor Harrell	Lee Engine Company, CA	775-778-7420
John Granger	Estancia FD, NM	505-384-2983
Mark Hall	Jefferson Co. FD, CO	303-972-4902
Ron Hill	Big Thompson Canyon FD, CO	970-663-4787
Artie Ray	Winterhaven FD, FL	863-291-5665
Jeff Bryant	Amboy FD, IL	815-857-2325
Lt. Bobby Bohn	Polk County FD, FL **	863-534-0380
Will Raulerson	Florida Division of Forestry, FL	904-985-2776
Brady Scott	Florida Division of Forestry, FL	407-302-5370
James Lowery	Brier Hill Fire District, NY	315-375-8663
Keith Litchfield	Great Valley Vol. FD, NY	716-699-4677
Cheryl Carvill	Hammond Fire Rescue, NY	315-482-2573
Wayne Luce	Kiatone FD, NY	716-484-0890
Kevin Crosby	Morristown FD, NY	315-375-4400
Robert Franklin	Odessa FD, NY	607-594-2157
Dale Seibert	Springbrook Fire Dist., NY	716-652-2670
Scott Smithson	Utica Converters, Inc. , NY	315-733-4626

CHECK OUT OUR WEB SITE: www.whiffs.net

* 120 man department

** 450 man department

NAVY SAFETY AND SURVIVABILITY OFFICE
REPORT OF NDI/COTS ASSESSMENT

Item Name: Xcaper® Civilian Smoke Mask

Date Received: 15 February 2002 **Date Submitted:** 15 April 2002

Manufacturer: Xcaper® Industries, LLC
1601 Dove Street, Suite 299
Newport Beach, CA 92660
(800) 351-3015

Description:
The Xcaper® Civilian Smoke Mask is designed as an "Emergency Escape Only" personal protection respirator. The Xcaper® Civilian Smoke Mask is advertised to filter out approximately 94% of smoke particulate matter and 100% of the gasses found in smoke. The Xcaper® kit comes with a dry mask, for practice use, and the actual wet mask packaged in an aluminized sealed envelope.

Assessment/Comment:
An assessment was conducted to determine the accuracy of the manufacturer's claims and ease of use. Test data provided by the manufacturer was reviewed to assess the performance claims and scenarios were used to assess the ease of use. According to test data provided, an independent test laboratory, Truesdail Laboratories, Inc., conducted the tests. The Xcaper® was subjected to various air sampling and particulate tests. The tests conducted by Truesdail Laboratories support the manufacturer's claims of smoke particulate and gas removal. Three participants assessed the Xcaper® for ease of use in a limited visibility environment. The mask packaging is easy to open with both wet and dry hands. The instructions for donning are clear and easily understood. Each participant was allowed to read the instructions and practice donning the dry mask. The Xcaper® mask was placed in a known location in an office setting and the lights were secured to restrict visibility. Each participant was to locate and don the mask and evacuate to a designated safe area. In each assessment, the participant was able to don the mask and escape to a safe area.

Recommendation:
Recommend this mask for potential use in Navy Facilities and DOD office environments.

REPORT OF NDI/COTS ASSESSMENT

ITEM: XCAPER® CIVILIAN SMOKE MASK

PREPARED FOR THE DEPARTMENT OF THE NAVY, DASN (SAFETY)
NAVY SAFETY & SURVIVABILITY OFFICE

UNDER DELIVERY ORDER NO. N00600-02-F-0872

BY

QUADELTA, INC.
85 SOUTH BRAGG STREET, SUITE 302
ALEXANDRIA, VA 22312-2793

TEL: (703) 354-0700
FAX: (703) 354-0701
E-MAIL: ctcus@quadelta.com

REPORT OF NDI/COTS ASSESSMENT

ITEM: XCAPER® CIVILIAN SMOKE MASK

PREPARED FOR THE DEPARTMENT OF THE NAVY, DASN (SAFETY)
NAVY SAFETY & SURVIVABILITY OFFICE

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QUADELTA INC.

85 S. Bragg Street, Suite 302
Alexandria, VA 22312
(703) 354-0700 Fax (703) 354-0701
www.quadelta.com

June 4, 2002

Xcaper® Industries, LLC
1601 Dove Street, Suite 299
Newport Beach, CA 92660

Attention: Mr. Robert G. Reese
Chief Operating Officer

Subject: Report of NDI/COTS Assessment of Xcaper® Civilian Smoke Mask

Enclosure: (1) Report, dtd 15 April 2002, NDI/COTS Assessment of Xcaper® Civilian Smoke Mask [2 pages]

Dear Mr. Reese:

QUADELTA, Inc. (QDI), is pleased to provide, at enclosure (1), in response to your request, a copy of the report submitted by QDI to the Director of Safety and Survivability (DIR(S&S)), in the Office of the Deputy Assistant Secretary of the Navy (Safety), ODASN(S), concerning the NDI/COTS assessment of the Xcaper® Civilian Smoke Mask which your company manufactures, markets, and distributes.

QDI, under Delivery Order No. N00600-02-F-0872, supports ODASN(S)/DIR(S&S) in conducting assessments of Non-Developmental Items (NDI) and/or Commercial-Off-The-Shelf (COTS) items that may have a potential use by the Department of the Navy. Such assessments are conducted pursuant to the overarching goal of the Federal Acquisition Streamlining Act (FASA) of 1994 (Public Law 103-355), which is to use commercial items to fill DoD requirements to the greatest extent practical. See Section 2.101 of the Federal Acquisition Regulation (FAR) for definitions of "non-developmental item" and "commercial item." Also, FAR Part 12 implements Title VIII of the FASA and prescribes the policies and procedures unique to the acquisition of commercial items.

Your special attention is invited to the Notice, Disclaimer of Liability, and Disclaimer of Endorsement on the cover of the report, including the statement that the report shall not be used for advertising or product endorsement purposes.

Should you have any questions about this report, please call either the undersigned at (703) 354-0700 or Mr. John C. Taggart at (757) 495-2921.

Sincerely,

David L. Walker III
Director of Contracts

cc: S&S/F. Crowson, Technical Director

TRUESDAIL LABORATORIES, INC.
INDEPENDENT TESTING, FORENSIC SCIENCE, AND ENVIRONMENTAL ANALYSES
Established 1931
14201 FRANKLIN AVENUE
TUSTIN, CALIFORNIA 92780-7008
(714) 730-6239 · FAX (714) 730-6462
www.truesdail.com

REPORT

XCAPER
1601 Dove Ste 299
Newport Beach CA 92660
Attn: Mr. Eric Ellison

Nov 2, 1999

Hydrogen cyanide removal efficiency

Testing was conducted on a mask supplied by XCAPER INC. Nitrogen containing 360 parts per million by volume was sent through the mask at approximately 5 liters per minute The gas exiting the bag was collected in a Tedlar bag and analyzed for Hydrogen cyanide using a Drager tube. The results are as follows.

Gas entering mask	360 ppmv HCN
Gas exiting mask	23 ppmv HCN

Michael Shanahan
Air Testing
Truesdail Laboratories

LIFE TECH
LN 100099

June 25, 1997
(2 - Hydrochloric Acid tests)

6/25 - This test had two identical sampling systems - one with the escape mask prior to the HCl collection system and one without a mask connected directly to the HCl collection system. The HCl collection system consisted of a set of 500 ml impingers charged with 100 mls each of water followed by a pump and calibrated dry gas meter. The impinger solutions were subsequently analyzed for CL^- by Ion Chromatography (IC).

The sampling was conducted for about 3 minutes at a target rate of 1 cf/min. The sampling was conducted within a test chamber that was continually being purged with a 1000 ppmv standard of HCl (balance nitrogen).

The results are as follows:

Sample	HCl ppmv
Mask	0.96
No Mask	334.
Removal efficiency:	99.7%

TRUESDAIL LABORATORIES, INC.

Michael Shanahan
Analytical Chemist
Air Pollution Testing

LIFE TECH
LN 100099

June 25, 1997
(2 - Acrolein tests)

6/25 - This test had two identical sampling systems - one with the escape mask prior to the acrolein collection system and one without a mask and connected directly to the acrolein collection system. The acrolein collection system consisted of an SKC silica coated/DNPH sorbent tubes (150/300) followed by a rotameter and an evacuated 30 liter. The sampling rate was set at 0.2 liters per minute for approximately 5 minutes.

The sorbent tube was analyzed by Modified USEPA Method TO-11 for acrolein content.

The sampling was conducted within a test chamber that was continually being purged with a 1000 ppmv standard of acrolein (balance nitrogen).

The results are as follows:

Sample	HCN ppmv
Mask	0.057
No Mask	35.5
Removal efficiency:	99.8%

TRUESDAIL LABORATORIES, INC.

Prepared by:

Michael Shanahan
Analytical Chemist
Air Pollution Testing

Reviewed by:

Charles M. Figueroa
Project Manager
Air Pollution Testing

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS
RESEARCH — DEVELOPMENT — TESTING

14201 FRANKLIN AVENUE
TUSTIN, CALIF. 92680
AREA CODE 714 • 730-6239
AREA CODE 213 • 225-1564
FAX 714 • 730-6462

CLIENT **Life Tech International, LLC**
92 Corporate Park, Suite C-732
Irvine, CA 92606
Attn: Mr. Erik Ellison

DATE July 3, 1997

RECEIVED June 19, 1997

LABORATORY NO. 100070-2

SAMPLE

Escape Mask Tests

INVESTIGATION

Particulate Removal Efficiency

RESULTS

Testing was conducted on June 19, 1997 for the determination of the particulate removal efficiency of the submitted Life Tech escape mask. The summary of these tests follows:

LIFE TECH
LN 100070-2

June 19, 1997
(2 - Particulate tests)

6/19 - This test had two identical sampling systems - one with the mask prior to the back-up filter and the other with directly into the back-up filter. The filter was glass fiber and rated at 10μ.

The testing was conducted for about 2 minutes with both sampling probes adjacent to each other. The positions were switched frequently to avoid any positional biases. The fire consisted of scrap construction wood and a vinyl record.

The sampling was targeted for a sampling rate of about 1 cf/min. As the filters clogged with particulate/oil the sampling rate decreased. Only during the last 30 seconds did one of the sampling systems (without the mask) begin to show flow rate constriction. The results are as follows:

Sample	Particulate mg/m3
Mask	70.0
No Mask	1185.
Removal efficiency:	94.1%

TRUESDAIL LABORATORIES, INC.

Prepared by:

Michael Shanahan
Analytical Chemist
Air Pollution Testing

Reviewed by:

Charles M. Figueroa
Project Manager
Air Pollution Testing

NOVASCREEN®

August 8, 2002

Mr. Robert G. Reese
Chief Operating Officer
Xcaper Industries, LLC
1601 Dove Street, Suite 299
Newport Beach, California 92660

Dear Mr. Reese:

This letter comprises my response to Xcaper Industries' request that I consider the performance characteristics of the Xcaper moist filter when that product is exposed to dioxins that are created as combustion by-products. My conclusions contained in this response were formulated after review of the technical characteristics of the Xcaper filter and relevant technical literature. The removal of polychlorinated dibenzo-p-dioxins and dibenzofuran materials (PCDD/F) from "mass burn" combustion off-gases is a critical element for defining Xcaper filter performance characteristics.

Let me initially provide a brief statement of the crux of the dioxin issue. During combustion PCDD/F are produced and dispersed primarily in the fly-ash fractions that constitute a portion of the off-gases. These PCDD/F-containing, fly-ash particulate elements of off-gases are routinely removed by the Xcaper filter. However, a fraction of the PCDD/F generated during combustion may initially exist in the gaseous phase at elevated temperatures (often approximately 50% of the total PCDD/F at around 200 degrees C). This volatile fraction of the PCDD/F may pass the particle filter at high temperatures so that an additional concern is the need to remove the gaseous PCDD/F from the off-gases at elevated temperatures.

It is important to consider the possibility that adsorption of the volatile PCDD/F to the fly ash particles and removal during cooling increases the efficiency of filtration. The efficiency of fly ash particles as a sink for PCDD/F has been evaluated. The gas/particle partitioning of the PCDD/F depends on the temperature, the material vapor pressure, the particle size, the particle number density and on the physical and chemical properties of the particle surface. These relationships have been investigated by model

7170 Standard Drive • Hanover, Maryland 21076-1334
410-712-4410 • Fax 410-712-4412 • 1-800-543-4141

calculations and by pilot scale experiments. At ambient temperatures, the gas/particle partitioning of the dioxin corresponds well to the sublimation equilibrium. At higher temperatures, it is much different from the sublimation equilibrium and the apparent adsorption enthalpy is smaller than the enthalpy of sublimation. The data suggest that the adsorption rate is not the limiting factor for the transfer into the particulate phase. Rather, the important factors appear to be the chemical composition of the fly ash and the temperature.

Seen through the prism of the Xcaper filter, these issues focus attention on the composition of filter materials and the extent of temperature decrease offered to the wearer during active use. That is, does the Xcaper filter provide a material matrix that is able to adsorb PCDD/F and does the Xcaper filter significantly reduce the temperature of transmitted hot gases. The responses to both of these issues are affirmative. The aloe-based filter material is a sufficiently lipophilic matrix to rapidly adsorb volatile PCDD/F, and the consistently moist nature of the filter materials significantly lowers the temperature of the transmitted hot gases.

I have concluded that the Xcaper moist filter would effectively remove both particulate and volatile PCDD/F and thus provide significant protection to the wearer when that product is exposed to dioxins created as combustion by-products.

Sincerely yours,

Peter S. Carlson, Ph.D.

Analysis

of

Expected

Xcaper Filter Effectiveness

Against

Dioxins, Furans, and Polychlorinated Biphenyls's (PCB's)

5 September 2002

James D. Lee, P.E.

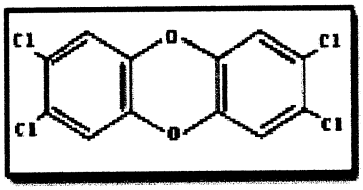
WMD Preparedness Services, Inc.

1. **GENERAL:** This document analyzes the expected effectiveness of the Xcaper Filter against dioxins, furans, and PCB's. It has been performed based on the solubility characteristics of dioxins relative to those of compounds found in aloe.

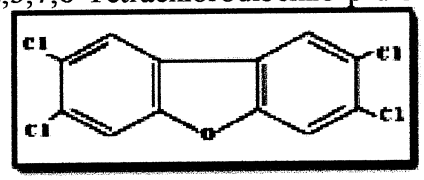
2. **BOTTOM LINE UP FRONT:** Analysis indicates that gasified dioxins, furans, and PCB's are soluble in the aloe vera gel used in the Xcaper Filter. The actual length of time that a given filter will protect the wearer against dioxins, furans, and PCB's will be dependent upon the concentration of these compounds in the air.

3. **XCAPER FILTER CHARACTERISTICS:** Xcaper Filters use a dynamic wet-filter technology. The filter media is composed of polystyrene beads suspended in an aloe vera gel that is 98% water. The filter media flows freely within the filter, preventing the formation of saturated channels in the filter. Gases are retained in the filter by two mechanisms: by adsorption, onto the surface of the polystrene beads and by dissolution into the aloe vera gel.

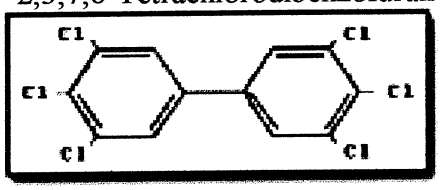
4. **CHEMICAL CHARACTERISITICS OF DIOXINS, FURANS, AND PCB'S:** Dioxins are a group of 75 similar compounds that includes furans and PCB's. They are produced through the combustion of chlorinated compounds in conjunction with hydrocarbons. They are highly toxic and persistent in the environment. They are not soluble in water, but are highly soluble in fats and oils. The most common means of exposure to dioxins comes from ingestion of beef, pork, fish, and milk. All are foods with a high fat content. Dioxins are also soluble in plant oils.



2,3,7,8-Tetrachlorodibenzo-p-dioxin

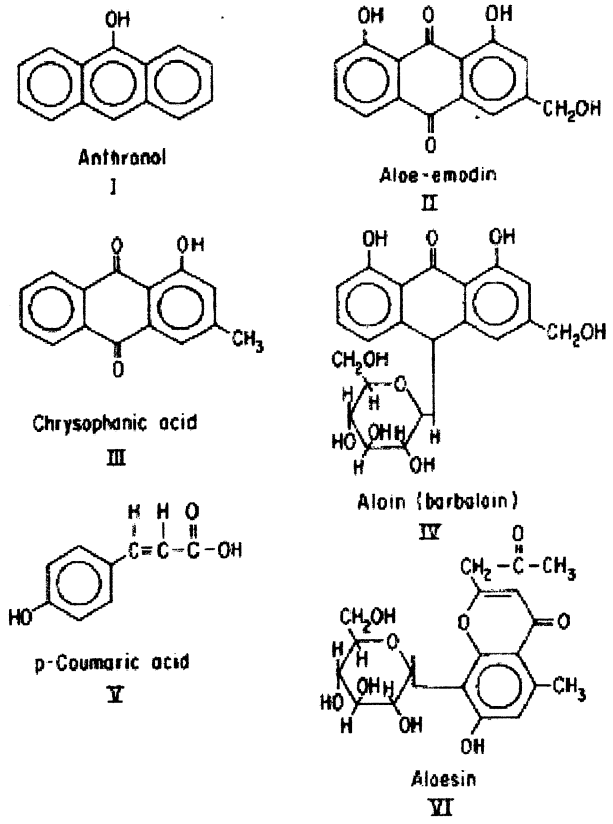


2,3,7,8-Tetrachlorodibenzofuran



3,3',4,4',5,5'-Hexachlorobiphenyl

5. **CHEMICAL CHARACTERISTICS OF ALOE COMPOUNDS:** The compounds commonly found in aloe vera are classified as polysaccharides. Polysaccharides are similar to dioxins, furans, and PCB's in composition because they also contain multiple benzene ring structures, but also have hydroxyl groups that make them soluble in water. Hydroxyl groups have a structure indicated by -OH.



Structural Formulae of Compounds Found in Aloe

6. **EXPECTED INTERACTION BETWEEN DIOXINS AND ALOE:** The polysaccharide compounds found in aloe vera gel are similar in structure to dioxins, furans, and PCB's; but they are also water soluble because of the presence of hydroxyl, or –OH groups in their structure. When the polysaccharides in the gel encounter dioxins, furans or PCB's; they will act as surfactants, facilitating the dissolution of the dioxins, furans, and PCB's into the gel. In this respect, the aloe polysaccharides act much the way soap does in facilitating the dissolution of oil into water.

7. **CONCLUSION:** Though formal testing remains necessary to determine the precise capacity of the aloe vera gel to dissolve gasified dioxins, furans, and PCB's; structural analysis indicates that the aloe vera gel used in Xcaper Filters will be capable of dissolving (absorbing) these compounds. This applies equally to other gases that are considered non-water soluble.

MISSION INTERNAL MEDICAL GROUP, INC

MISSION INTERNAL MEDICAL GROUP, INC.

CHIEF EXECUTIVE OFFICER
Dennis A. Wolin, MBA

CHIEF OPERATING OFFICER
Carole A. Jacolick, MT, BS, HCM

MISSION VIEJO OFFICE:

INTERNAL MEDICINE
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June 23, 2000

Airflow Efficiency Testing

PURPOSE OF THE TEST: **A test was performed to determine the airflow efficiency of a standard N95 filter during strenuous exercise and its effects on oxygenation ventilation and acid-base balance.**

TEST PROTOCOL: **Testing was performed in the pulmonary physiology laboratory at a regional medical and trauma center under the direction of a board-certified physician with extensive experience in exercise physiology. An MVMax Sensormedics Series 229 cardio system was used. The subject was a normal, well-conditioned 53-year-old male.**

The subject was fitted with a standard N95 filter with an exhalation valve. The filter was inserted into a Nomex shroud, The Hot Shield®, and was worn by the subject. A bicycle ergometer, an Ergometrics 800 made by Ergoline, was used. A 15-watt ramp protocol as reported previously was used.

The subject's heart rate, respiratory rate and oxygenation were continuously monitored and arterial blood gas measurement was performed at the termination of the exercise. The workload increased from 15 watts to 175 watts and the subject exercised 13 minutes. Testing was terminated because of exhaustion and impaired ventilation. The subject also experienced a prolonged headache following testing.

RESULTS: **The results of the two tests were as follows:**

N95 filter Workout		Xcaper™ Filter Workout	
Heart rate	149	Heart rate	102
pH	7.36	pH	7.435
pO2	94.0 mmHg	pO2	93.0 mmHg
Respiratory rate	36/min	Respiratory rate	25/min

INTERPRETATION:

The findings document significantly increased energy expenditure while wearing a standard N95 filter encased in a Nomex shroud. Although there was no adverse effect on oxygenation, there was a significant increase in heart rate and respiratory rate and an associated metabolic acidosis. This level of energy expenditure and metabolic acidosis was not noted while wearing the Xcaper™ Filter using the same exercise protocol.

This data is available for independent review. Please contact:

Dr. Bruce R. Tammelin, MD FCCP
Director of Respiratory Care, MHRMC
26732 Crown Valley Parkway, Suite 131
Mission Viejo, CA 92691
(949) 364-6000

or

Xcaper™ Industries, LLC.
(949) 852-2021

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February 25, 2000

Carbon Dioxide Testing and Airflow Efficiency

PURPOSE OF THE TEST: Tests were performed in order to determine if a significant build-up or accumulation of carbon dioxide occurred while using the Xcaper ™ filter and Whiffs™ mask during strenuous exercise. The airflow efficiency of the filter was also tested.

TEST PROTOCOL: All tests were conducted in the pulmonary physiology laboratory at a regional medical and trauma center under the direction of a board certified pulmonary physician with extensive experience in exercise physiology. An MVMax Sensormedics Series 229 cardiosystem was used. The subject was a 53-year-old male, office worker.

Baseline determinations for VO2–mL/kg/min, VCO2 – L/min, VE (minute ventilation) heart rate and work watts while riding a Bicycle Ergometer (Ergometrics 800 manufactured by Ergoline) were made. A 15-watt ramp protocol was used. The baseline data was obtained during 12 minutes of work and 3 minutes of recovery. The workload increased from 15 watts to 175-200 watts. An arterial blood gas sample was obtained at peak exercise at 12 minutes. Arterial pH, pCO2, and PO2 were measured following exercise without the mask and filter. The subject was allowed to rest for 20 minutes following the baseline study.

Using the same bicycle and the 15-watt ramp test, the subject repeated the exercise protocol while wearing the mask and filter apparatus. At the 12 minute mark (peak exercise) a repeat arterial blood gas sample was obtained.

RESULTS:

Baseline Workout		Mask & Filter Workout	
F1O2	21%	F1O2	21%
PH	7.398	pH	7.435
PCO2	42.2 mmHg	pCO2	44.4 mmHg
PO2	94.0 mmHg	pO2	93.0 mmHg
Minute Ventilation – 48 L. (steady state)		Minute Ventilation – 49.8 L. (steady state)	
O2 consumption – 24.0 ml/kg/min. (steady state)		O2 consumption – 25.3 ml/kg/min. (steady state)	

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INTERPRETATION:

There was no significant retention of carbon dioxide using the mask/filter apparatus following exercise. The work of breathing and oxygen consumption were essentially unchanged with use of the device. There was no impairment in oxygenation at peak exercise. Minute ventilation as a reflection of airflow resistance was essentially unchanged during mask/filter use.

This data is available for review. Please contact:

Dr. Bruce R. Tammelin, M.D., F.C.C.P.,
Director of Respiratory Care, MHRMC
26732 Crown Valley Parkway, Suite 131
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BRT/slh

SOME NOTES ON THE OPERATION OF THE XCAPER™ SMOKE FILTER AND HOW IT COMPARES TO OTHER AIR PURIFYING FILTERS OF DIFFERING CONSTRUCTION

The Xcaper™ Smoke Mask works by trapping gaseous and particulate contaminants (often referred to as aerosols by smoke researchers) within a filtering medium similar to the "packed bed" filters commonly used in the chemical processing industry. Many such so-called mechanical filters, which do not rely on chemically reactive or catalytic components, are in widespread use in hazardous chemical and industrial environments; their efficiencies can approach 100%. They are often used to purify air by filtering out not only dusts and mists but also organic and acid gases such as carbon monoxide, carbon dioxide, hydrogen chloride, and many others. Many varieties of mechanical filter type purifying masks are available through industrial and laboratory safety supply houses. Several have been tested and investigated by NIOSH and other organizations for both filtering efficiency and tightness of fit. Vendors who market such personal respiratory devices through established industrial safety supply outlets publish performance data that suggests that these masks can be very effective filtering devices, indeed, when used within their prescribed limits.

Claims have been made that higher filtering efficiencies can often be achieved with "chemical" filters, those that rely on transformation of harmful contaminants by involving them in a chemical reaction as they pass through the filter medium. The reaction changes the chemical nature of the contaminant to something harmless (usually a relatively inert solid which remains trapped within the filter). This type of filter, however, must be chosen for a specific toxic species or a very limited range of species, as the reaction mechanism is tailored to a particular type of substance.

Since smoke from fires is a complex mix of particles, liquid droplets, gases, and sticky agglomerated mixtures of all three, chemically reactive filtering media, regardless of sophistication, cannot be expected to provide sufficient protection for all of the products of combustion which may be a threat to life-safety. As reactive media fill up with trapped particulates and the residues of reacted products, they become markedly less efficient. Breathing through them also becomes more difficult as the partially blocked air passageways produce a large pressure drop, which the wearer must overcome by breathing through the filter with more force. Chemically reactive filters also generate considerable heat through the chemical reaction mechanism, causing the breathable air to become in many cases too hot. The purported advantages of high capture and retention efficiencies of such filters, therefore, would not be borne out in most real fire situations.

Unlike chemical filters, the Xcaper™ filter can act effectively on a wide range of substances and actually become more efficient with use, as the trapped contaminants act to further obstruct the path of newly entering contaminants. The air passageways remain relatively free of obstruction since the filter acts primarily by adsorbing contaminants onto electrochemically active surfaces of otherwise inert filter material. No additional reaction products are created, and the adsorbed material is effectively removed from further interference with the passing stream. Adsorption continues even with particulate build-up because the micro scale electrochemical activity continues unabated. The growing quantity of adsorbed material acts only to further slow the passage of the coagulation aerosols, providing more "residence" time for the capture to take place. The filter, thus, becomes more efficient over time. Saturation will be approached but only very slowly and, as field tests have shown, the time to saturation is much greater than the time of anticipated use.

EXAMINATION OF THE POSSIBLE MICROSCALE PHYSICAL/CHEMICAL MECHANISMS RESPONSIBLE FOR THE OBSERVED PERFORMANCE OF THE XCAPER™ SMOKE FILTER

The Xcaper™ filter is a new type of smoke filtering device claiming a very high level of efficiency in filtering out the toxins and particulate products of combustion from common fires. A professional fire protection device called WHIFFS™, Wilfire Hazardous Inhalation Firefighters' Filtration System, holds an Xcaper™ filter in a protective Nomex™ shroud that is worn over the nose and mouth and allows the wearer to breathe normally, maintain a clear line of vision, and keep both hands free.

The Xcaper™ filter has undergone rigorous laboratory testing through an independent laboratory and it has also been informally field tested under a variety of conditions. Since the filter eliminates a significant percentage of the gas phase products of combustion, a question arises as to how the observed effectiveness of the filter in preventing toxic substance build-up in the body for extended periods of up to 4 hours or more can be explained. The purpose of this paper is to identify several possible physical and chemical mechanisms by which the filter's performance may be explained and is the result of extensive discussions with individuals highly educated in fire science.

The functional aspects of the filtering process are complex. They are dependent on details of the filter's construction as well as on the physical and environmental conditions of use. Among the most readily identifiable mechanisms are the following:

(1) As a rather densely packed collection of small plastic beads in a contained natural gel bath, the filter behaves most fundamentally as a simple physical absorption device, utilizing a large enclosed volume for 'storage' of breath-entrained combustion particulate matter.

(2) The active thickness of the filter offers substantial interference with the path of smoke particulates drawn in through the normal breathing process. Given the internal packing structure of fine beads and relatively small void fraction it is clear, even without quantification of the effect, that the mean travel distance (mean path length) of a smoke particle from outer to inner surface of the filter would be several times the direct linear thickness of the filter. As interstitial spaces (between the beads) fill with trapped particulates, mean path lengths would increase far more, delaying arrival of particulates at the inner surface.

(3) Over the course of active travel of combustion particulates, well known "aging" effects alter both their character and behavior. This widely observed phenomenon, generally termed coagulation, describes the agglomeration and coalescing behavior of gaseous, liquid, small solid and aerosol products into much larger masses whose number and size vary in a complex manner with both time and ambient temperature. Coagulation traps large numbers of toxic gas molecules within the clotted mass, the effect being enhanced by longer residence times and cooler temperatures.

(4) The physical structure of a smoke particulate may be thought of as characterized by a large surface area and a variable surface electric charge resulting from the polar structures of its constituent molecules. Polar charges of the far smaller molecules of the remaining free gaseous combustion products will eventually cause electrochemical adsorption of the gases onto the surfaces of the particulates. Due to the very large-scale difference between a gas molecule and even the smallest of particulates, it is likely that thousands of gas molecules can adhere to the surface of a single particulate given sufficient residence time for adsorption to occur.

(5) Most common gases, especially those typically found as combustion by-products, are soluble in water and other solvents and natural gels. Free gases not yet trapped by aerosol formation or by adsorption/coagulation processes are subject to secondary entrapment through dissociation in a solvent gel.

Still other mechanisms may be of importance, particularly as they affect the movement of ionic or surface charged species through the filter. Among these are electrolytic solution tension effects (i.e., Helmholtz double layer effects), electrophoretic effects, and potential equilibrium altering gas-solvent reactions. Such "secondary" mechanisms could be considered insignificant, but the exceedingly long reaction residence times characteristic of this type of filter may lead to enhanced effects which would not normally be expected.

SUMMARY

In view of the major roles played by such processes as adsorption, aerosol formation and coagulation in typical fire and smoke aging processes, it is likely that these mechanisms, along with the added effects of absorption, interference and solvent-induced dissociation, are also important in accounting for the observed performance of the Xcaper™ filter. It is also possible that other mechanisms related to microscale details of the electrochemical environment within the filter can be identified as possible contributors.

Coastal Systems Station
NSWC Dahlgren Division
Code A51 - Gas Analysis Laboratory
6703 W. Hwy 98
Panama City Beach, FL 32407-7001

26-Nov-01

Mr. Robert G. Reese
Chief Operating Officer
Xcaper Industries, LLC
1601 Dove Street
Suite 299
Newport Beach, CA 92660

RE: Offgas analysis of Xcaper Filter (M106220).

Robert:

I have had the opportunity to perform offgas testing on one of your filters. The paragraphs and tables below summarize the results of that testing. The tests were conducted on 2-Nov with a mask freshly removed from its foil packaging.

The above sample was placed in a 3,800 cubic-centimeter offgassing chamber that had been precleaned to ensure a zero hydrocarbon background. The chamber was then charged to 180 psig with high purity (zero) air. The hydrocarbon content of the contained sample was then allowed to equilibrate with the zero air for 4 hours at 160°F(71.1°C) before an analysis for specific and total hydrocarbons. The analysis yielded the following results:

COMPONENT	MEASURED LEVEL	TIME WEIGHTED AVG PERMISSABLE EXPOSURE LIMIT	NOTES
Total Hydrocarbons	37.8 PPM		
Total Halogens	0.1 PPM		
Carbon Monoxide	1.3 PPM	50 PPM (OSHA)	1
Carbon Dioxide	240 PPM	5000 PPM (OSHA)	1
Acetone	0.9 PPM	1000 PPM (OSHA)	
1-chloro-2-methylbenzene	1.7 PPM	50 PPM (ACGIH)	1,2
Methanol	5.3 PPM	200 PPM (OSHA)	1
Pentane	5.3 PPM	1000 PPM (OSHA)	1,2
Styrene	1.0 PPM	100 PPM (OSHA)	1,2
Toluene	<0.1 PPM	200 PPM (OSHA)	1
Xylene(s)	<0.1 PPM	100 PPM (OSHA)	1

The results herein are applicable only to the sample described above. Test chamber volume, pressure, and amount of material used must be considered when evaluating results. The described testing and results are provided for informational purposes only. Testing and/or the results reported are not meant to imply approval, recommendation, or acceptance of any material by Coastal Systems Station or the Department of the Navy.

If you have any questions about the information provided, please do not hesitate to contact me. I will be happy to discuss any aspect of the analysis with you or one of your representatives.

Best Regards,

Bill Bradley
Scientist

NOTES:

1) TWA PEL source: Dangerous Properties of Industrial Materials, 7th ed.
2) Measured level was estimated based upon instrument response to Benzene.

Peabody Fire Dept.

Peabody, Massachusetts

Official Web Site

Carbon Monoxide Information

Levels of Carbon Monoxide...

Flamability: will explode; LEL 12.5%
Classification: Health: extremely toxic

Carbon Oxide, Flue Gas, Monoxide

- Symptoms
- Sources of CO
- Levels of CO
- Free CO Info
- What to Do IF
- Safety Tips

Carbon monoxide is a colorless gas. To the human senses it is invisible. Carbon monoxide is a by-product of combustion and will appear naturally in any situation where burning has taken place.

Carbon monoxide is a highly toxic gas which is termed a toxic asphyxiant, meaning it reduces the oxygen transport properties of the blood. It reacts with the hemoglobin in the blood forming carboxyhemoglobin which prevents the hemoglobin from transferring oxygen. Low ppm doses of carbon monoxide can cause headaches and dizziness. If the victim is removed to fresh air no permanent damages will result. High doses can be fatal.

Effects of Various CO Levels

PPM	Resulting Conditions and Effects on Humans
50	Permissible Exposure Level for 8 hours (OSHA)
200	Possible mild frontal headache in 2 to 3 hours.
395	Frontal headache and nausea after 1 to 2 hours. Occipital after 2-1/2 to 3-1/2 hours.
800	Headache, dizziness, and nausea in 45 minutes. Collapse and possible death in 2 hours
1600	Headache, dizziness, and nausea in 20 minutes. Collapse and death in 1 hour.
3200	Headache and dizziness in 5 to 10 minutes. Unconsciousness and danger of death in 30 minutes.
6395	Headache and dizziness in 1 to 2 minutes. Unconsciousness and danger of death in 10 to 15 minutes.
12,800	Immediate effects-unconsciousness. Danger of death in 1 to 3 minutes.

Source: American Industrial Hygiene Association

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TABLE II. Exposure Standards and Guidelines for the Interpretation of Firefighter Exposure Data

Chemical	OSHA PEL	ACGIH TLV	NIOSH REL	STEL[A]	IDLH[A]
Acetaldehyde	200 ppm	—	LF[A]	25 ppm (C)[B]	2000 ppm
Acrolein	0.1 ppm	—	0.1 ppm	0.1 ppm (C)[B] 0.3 ppm[C]	2 ppm
Asbestos	0.1 f/cc	0.1 f/cc	LF	—	—
Benzene	1 ppm	0.5 ppm	0.1 ppm	2.5 ppm[B] 1 ppm[C]	3000 ppm
Benzaldehyde	—	—	—	—	—
Carbon monoxide	50 ppm	25 ppm	35 ppm	200 ppm (C)[C]	1200 ppm
Formaldehyde	0.75 ppm	—	0.016 ppm	2 ppm[D] 0.3 ppm (C)[B] 0.1 ppm (C)[C]	20 ppm
Glutaraldehyde	—	—	—	0.05 ppm (C)[B] 0.2 ppm (C)[C]	—
Hydrogen chloride	—	—	—	5 ppm (C)[B–D]	50 ppm
Hydrogen cyanide	10 ppm	—	—	4.7 ppm[C] 4.7 ppm (C)[B]	50 ppm
Isovaleraldehyde	—	—	—	—	—
Nitrogen dioxide	—	3 ppm	—	5 ppm (C)[B,D] 1 ppm[C]	20 ppm
Particulates, respirable	5 mg/M^3	3 mg/M^3	—	—	—
Particulates, total	15 mg/M^3	10 mg/M^3	—	—	—
Sulfur dioxide	5 ppm	2 ppm	2 ppm	5 ppm[B,C]	100 ppm

[A]IDLH = immediately dangerous to life or health; LF = lowest feasible concentration; C = ceiling (not to be exceeded).
[B]American Conference of Governmental Industrial Hygienists (ACGIH).
[C]National Institute for Occupational Safety and Health (NIOSH).
[D]Occupational Safety and Health Administration.

are considered to be carcinogens. Because during overhaul activities there is little or no smoke, the presence of PNAs was not expected. Although the OSHA PEL (0.2 mg/M^3) was exceeded for coal tar pitch volatiles at one fire, this may be the result of fire suppression activities that were continuing on the roof when the monitoring commenced inside the structure.

Due to suspected interference from extreme temperature and humid environments, invalid results were experienced on the direct-read instrument for HCN. Samples collected using NIOSH Method 6010 were either below the LOD or too low to quantify. As a result of these findings and in consideration of other published studies[4,7,8] that have quantified HCN at extremely low concentrations, the readings obtained from the four-gas meters were eliminated from further analysis.

The chemicals found to exceed occupational exposure limits in this study have the potential to cause adverse health effects in firefighters. Acrolein produces intense irritation to the eye and mucous membranes of the respiratory tract. Acute exposures may result in bronchial inflammation, resulting in bronchitis or pulmonary edema. Carbon monoxide is present in all fire environments as a product of incomplete combustion and decreases the oxygen transport of the blood, which results in an inadequate supply of oxygen to the tissues. Adverse health effects due to formaldehyde may occur after exposure by inhalation, ingestion, or skin contact. Eye irritation can occur at concentrations of 0.01–2.0 ppm, irritation of the nose and throat at 1.0–3.0 ppm, and severe respiratory symptoms at 10–20 ppm.[13] Formaldehyde is classified as a probable carcinogen.[10,12,14] Glutaraldehyde is a potent sensory irritant with the capability to cross-link, or fix proteins. SO_2 is irritating to mucous membranes of the upper respiratory tract. Chronic exposures may result in fatigue, altered sense of smell, and symptoms

TABLE III. Summary of Data on CO, NO_2, and SO_2 Obtained from Direct-Read Four-Gas Meter

Gas	Number of Samples	Average Sample Time (min)	Average Sample Conc.	STD DEV	MAX	Average Calculated 8-hour TWA[A]	MAX TWA
CO	65	42.2	52.6 ppm	66	260[B] ppm	3.95 ppm	26.9 ppm
CO[C]	65	10	89.5 ppm	134	671[B] ppm	—	—
NO_2	65	42.2	0.24 ppm	0.64	3.6 ppm	0.017 ppm	0.31 ppm
NO_2[C]	65	10	0.13 ppm	0.21	0.89 ppm	—	—
SO_2	65	42.2	1.60 ppm	2.06	8.69[D] ppm	0.114 ppm	0.71 ppm
SO_2[C]	65	10	2.95 ppm	4.91	21.7[D] ppm	—	—

[A]TWA = time-weighted average.
[B]Exceeded NIOSH ceiling—200 ppm.
[C]Average of first 10 min of readings.
[D]Exceeded ACGIH/NIOSH STEL—5 ppm.

WMD Preparedness Services, Inc.

Chemical, Biological, Radiological, and HAZMAT Terrorism Preparedness Consulting

August 26, 2002

Robert G. Reese
Chief Executive Officer
Xcaper Industries, LLC.
1601 Dove Ste 299
Newport Beach, CA 92660

Dear Mr. Reese,

It was a pleasure to speak with you by phone late last week as I was gathering information about the Xcaper Filter. As you know, I am a Licensed Professional Chemical Engineer. After my graduation from West Point in 1982, I was commissioned into the Army Chemical Corps and now have over twenty years of experience in the use, fitting, and maintenance of protective masks as both a military advisor and as a civilian Weapons of Mass Destruction consultant.

In reviewing information regarding the Xcaper Filter I have developed a great deal of respect for your product. I thought that you might be interested in my preliminary findings. Please feel free to consider the following as an endorsement of the Xcaper Filter, yours to use as you wish.

I feel confident in recommending the Xcaper Filter for use to my clients as an escape mask. I believe that based on testing to date and firefighter testimonial I can, with good conscience, recommend it for use up to 30 minutes in escaping from a high-rise or other endangered structure. I also believe that further testing will show that the Xcaper Filter will perform well for times well beyond 30 minutes.

My preliminary analysis of the Xcaper Filter based on common physical and chemical principles revealed that the styrene bead/aloe vera gel packing of the mask has several desirable characterisitics that enable it to entrap particulates, water soluble gases, and non-water soluble gases.

Filter Characteristics: The Xcaper filter contains polystyrene beads suspended in an aloe vera gel. The bead/gel filling is held in a polyester covering with a weave rating of 5.3 ounces per yard. Its overall weight is 2.2 ounces. The filter is similar to a beanbag in design. Two retaining straps are affixed to fit over the head and hold the filter in place. The filter is designed to cover the nose and mouth, molding itself to the wearer's face. It does not cover the eyes but goggles may be purchased separately from Xcaper. In use, the filter maintains a seal on the wearer while allowing facial movement during speech, breathing, and other movement of the jaw. Facial movement in turn generates a circulatory flow in the bead/gel contents. The light weight and conformity of the filter make it easy to wear. Separate goggles provide an additional advantage to the wearer by preventing fogging from exhaled breath.

Physical and Chemical Principles Analysis:

Analysis by component:

a. Polystyrene beads: The polystyrene beads possess a negative static charge. Most particulates possess a positive charge. The result is that particulates will tend to be drawn to the polystyrene beads and trapped within the filter by static charge. The beads also provide a hydrophobic surface for the adsorption of non-water soluble gases.

b. Aloe vera gel: This gel is hospital grade. It is 98% water. In hospitals a steam is passed through this gel to rehydrate the lungs of burn victims. Aloe vera is known to have a soothing effect on damaged lungs. The gel also has a pH just under 9, meaning that it will absorb and neutralize acidic gases such as hydrogen cyanide and hydrogen chloride. The high pH gel will also readily dissolve carbon dioxide as it is exhaled from the wearer. The collection of carbon dioxide within the gel will lead to the formation of a carbonate-bicarbonate buffering system. This will offset any pH drop that might otherwise be caused by the absorption of acidic gases and keep the gel at a stable pH above 8.

   i. Suspended water in the gel: Since the gel is 98% water it will readily absorb water-soluble gases. Some of these gases will remain in molecular form, others will dissolve into ionic salts. Gases are less soluble in water as heat rises, but the water content of the filter itself helps to regulate heat build-up. The actual capacity of the filter to absorb water-soluble gases is unknown but can be determined through further analysis and testing. It should easily exceed the amount a wearer would encounter within a thirty-minute period. The presence of so much water within the gel will force non-water soluble gases that enter the filter to initially adsorb onto the polystyrene beads before being dissolved into the gel as described below.

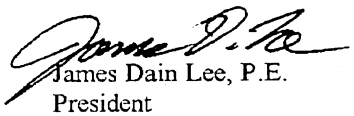
   ii. Aloe vera: The aloe vera in the gel will act as a surfactant, or surface active agent. This means that it will enable the gel to absorb non-water soluble gases that have been adsorbed onto the polystyrene beads. The actual capacity of the filter to absorb non-water-soluble gases is unknown but can be determined through further analysis and testing. It should easily exceed the amount a wearer would encounter within a thirty-minute period.

c. Polystyrene bead/gel mix: This filter possesses an advantage over filters with stationary, or static, packing. Static filters often fail due to the development of saturated channels through the filter. When channels develop, the bulk of the filter remains unsaturated, but saturated pathways develop through the filter that then act as a wicks, facilitating the passage of dangerous substances through the filter. By contrast, the dynamic movement of the bead/gel mix in the Xcaper filter in response to the wearer's facial movements prevents such channels from forming and will increase the functional capacity of the Xcaper filter over that of static filters with comparable absorptive capacities.

d. Polyester filter cover: This cover is heat treated and has passed flame resistance testing according to California Code 117e, meaning that it will resist combustion for 38 seconds when exposed to direct flame.

Conclusion: The Xcaper filter is impressive in its versatility and simplicity. It is suitable for use as an escape filter with anticipated exposures of up to thirty minutes. It does require further analysis and testing to fully document its capabilities and to determine precisely how long it can be used. I anticipate that this testing will indicate the Xcaper filter is suitable for wear beyond thirty minutes under most circumstances.

Very Truly Yours,



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