A Review of The Sponge-Jet Sponge Blasting™ System For Surface Cleaning & Paint Coatings Removal In UK Aerospace Military Markets

Sponge-Jet, Inc. – USA

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(1) Introduction & Acknowledgments:

The Sponge-Jet low-dust blast cleaning surface preparation system is used by major international companies and contractors spanning a broad raft of onshore and offshore industries. This paper provides an overview of the system's technical and operational development in conjunction with **BAE SYSTEMS** for military aerospace projects in the United Kingdom.

As reports of Sponge-Jet and BAE SYSTEMS projects are restricted under a commercial confidentiality agreement between parties, the author will not be detailing many of BAE's specific activities in this paper. However, the narrative will demonstrate the overall objectives of BAE - and review how Sponge-Jet's media products have been developed and employed to meet a wide range of technical applications and operating criteria.

Sections of this report narrative also include general domain facts and opinion collated from Sponge-Jet's long-term in-house trials and testing programs on metallic and composite substrates used across many military aerospace and civilian aviation industries.

Sponge-Jet Inc. and its European entity Sponge-Jet BV are indebted to BAE SYSTEMS management and staff at Dunsfold, in the UK, for the professional integrity, technical expertise, and commercial drive they have demonstrated over the past four years. Their input has been invaluable to Sponge-Jet and enabled us to develop a relatively-new concept into a cost-effective and flexible operating tool for many aerospace surface preparation tasks on metallic and composite materials.

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(2) Sponge-Jet System Overview

The Sponge-Jet Sponge Blasting™ process rapidly removes organic paint coatings and contaminants from metals and other composite and is a very flexible tool where traditional blasting is outlawed due to the health hazards caused by clouds of airborne dust - and where operators are restricted in the use of chemical strippers or high pressure water jetting techniques.

The heart of the Sponge Blasting system is range of urethane sponge granules embedded with various types and grades of abrasive particles or non-abrasive mineral fillers. For aerospace applications Sponge-Jet produces Aero-Alox™ 320 media containing very fine aluminium oxide - White Sponge™ media incorporating urea plastic chip - and Green Sponge™ media with non-abrasive mineral filler. Information on Sponge-Jet's range of Sponge Media™ material used by other industries may be reviewed on our website at www.spongejet.com.

The media is poured into the Sponge-Jet Feed Unit™ where a rotating auger screw entrains the sponge in a high pressure air stream. The air then transports the media through a hose and blast nozzle to impact the work surface at 30 to 100 metres per second. The feed units, which are 85 or 240 litre capacity and can be fitted with 9 or 12mm venturi blast nozzles, may be powered from any 7 bar rotary-screw compressor capable of supplying clean dry air at 6 to 10m3/min. For most aerospace applications the pressure at the blast nozzle will generally be set at 1.0 to 3.4 bar.

On impact with the work, the sponge granules flatten out and lose energy - the abrasive or filler particles remove the paint coatings and contaminants - and the media rebounds at low velocity. At just 400mm from the work, you can deflect rebound sponge with a bare hand without injury.

(3) Low-Dust Media - Heath & Safety Benefits

Unlike traditional grit blasting abrasives, or conventional plastic media, Sponge-Jet's open-cell sponge granules trap freed surface contaminants and dumps the fine debris on the floor. Typically, Sponge-Jet operations produce less than 10 percent of the airborne dust generated by other open blasting methods. This important low-dust feature provides significant health and safety benefits - particularly where chromate based aerospace paint coatings are being removed.

Because rebound Sponge Media material has very low energy, you only need a lightweight plastic tent around the work area to contain the media for recycling. This easily erected tent-style containment enables other trades to work safely adjacent to Sponge-Jet operations - and you save money as expensive heavy-duty blast-room facilities are not required. However, while Sponge-Jet equipment is usually viewed as a stand-alone system, it can be readily integrated into many existing plastic media blast-room facilities at minimum cost.

(4) Sponge Media Recycling

Sponge-Jet Sponge Media material is designed to be recycled at least 5 times and, on many projects, particularly at low blast pressures, operators regularly achieve 7 or more recycles. Used media is easily collected up manually, or with an industrial vacuum cleaner, and it is then sifted using a US manufactured Vorti-Siv™ vibrator style classifier - or a Dutch made rotating drum style sifter unit.

Both sifters employ a series of wire mesh screens to separate contaminant debris (by particle size) from reusable Sponge Media material. The Vorti-Siv sifter has a higher media throughput capacity than the rotary unit - but the Dutch unit is quieter in operation.

These sifters are air driven and require a dry-air supply of 1.0 to 2.0m3/min at 6 to 7 bar. They can be powered directly from the blast air compressor or from a suitable plant ring-air supply. To maintain the low-dust benefits of the Sponge Blasting system, Sponge Media material should always be sifted before being reused. Sponge-Jet also recommends that operators employ a media replenishment top-up protocol to maintain cutting efficiency and achieve optimum paint coating removal speed.

(5) Background To BAE SYSTEMS Operations

In 1997, British Aerospace, Military Aircraft & Aerostructures (now styled BAE SYSTEMS) established a joint trials and teaming protocol with Sponge-Jet to determine how the Sponge Blasting process could be adapted for cleaning oils, grease and other surface contaminants from inside the lower fuselage sections of Royal Air Force Nimrod aircraft.

The actual refurbishment work on the Nimrod aircraft was being undertaken by a third-party aircraft maintenance operator in the UK - and initially they cleaned one aircraft using pressure wash water jetting facilities. This wet process, however, required an extensive post-jetting dehumidification program, which restricted other trades from working inside the aircraft during this period.

A series of trials proved that Green Sponge media, containing wollastonite mineral filler, was suitable for this particular work on Nimrod, and BAE issued a Specification enabling the third-party company to switch to the dry sponge process. This improved operating efficiency and saved time as there was no requirement to dehumidify the hull after Sponge Blasting. Four RAF Nimrod aircraft were cleaned using Green Sponge media and the program is ongoing for similar work which is now being undertaken in-house by BAE SYSTEMS.

The BAE trials and work program on the Nimrod's did highlight the importance of masking various stringers and access ports inside the aircraft to stop the ingress of sponge granules. BAE has researched and developed several adhesive tape and plug masking techniques to overcome this problem which is also encountered when blast cleaning with conventional plastic media and other similar products.

Sponge-Jet's trials and project work with BAE using dry Green Sponge media have demonstrated that the process is very effective for general cleaning and that while loose paint is removed - well adhering coatings remain intact and generally the process can produce a feathered edge suitable for the application of new coatings. Where there are heavy thick deposits of oils, greases and other residues - it is generally more cost-effective to remove these prior to Sponge Blasting using approved aerospace degreasing agents or cleaners; like Dasic CD1 for example.

Generally, Sponge-Jet Green Sponge media can be used to clean aerospace organic primers and topcoats without abrading the painted surfaces. At low blast pressure - and by varying the angle of the nozzle in relation to the work surface - it is possible to clean off light contaminants and retain the gloss on many paint systems. At medium blast pressures, Green Sponge media will produce a slight matte finish, which improves surface adhesion for subsequent coatings.

(6) Sponge-Jet Aero-Alox™ 320 Media

During our continuing development work with BAE, Sponge-Jet produced Green Sponge media loaded with higher than normal weights of wollastonite filler - and this media, particularly at higher blast pressures, was capable of stripping paints from aluminium and composite aircraft assemblies. The strip rate was generally slow but totally controllable - and operators appreciated the higher visibility resulting from low airborne dust levels.

To speed up the process - and following extensive dialogue with Martin Cutler and the team at BAE Dunsfold who ran numerous tests - Sponge-Jet developed a new range of specialist media incorporating 200 to 400 screen aluminium oxide abrasive in the polymer granules. Extensive trials in the UK, and with technical specialists at Boeing in the US, has shown that 320 screen abrasive produces optimum cleaning speed and highly controllable results on a wide range of metallic and composite substrates. Sponge-Jet has designated and registered this product as Aero-Alox™ plus a number which refers to the screen size of the aluminium oxide particles. In recent and current projects with BAE we have employed Aero-Alox™ 320 media for the majority of de-painting work on metallic and composite aircraft, aerospace components, and Radomes.

(7) BAE - Sea Harrier De-Painting Project

During April 1999, the BAE Dunsfold specialists - supported by Sponge-Jet BV and management from OIS plc, the UK distributor for our products - ran a de-painting project on an aluminium Sea Harrier plus additional trials on a broad range of composite materials.

This program was conducted inside a purpose built 12.80 x 12.80 x 5.30 metres high PVC Sponge Blasting tent fitted with large inspection viewing windows - and service ducts for compressor hoses and other services. Because chromate based coatings were used on this aircraft, BAE installed a HEPA (High Efficiency Particulate Attenuation) air filtration system in addition to the company's standard Health & Safety protocol packages. The HEPA system used has an air extraction capacity of 115m3/min

and retains 99.9 per cent of airborne dust down to 0.3 microns. The equipment consists on a freestanding filter box inside the blast tent, which is connected via a flexible duct to the main fan-driven filter unit situated outside the hanger.

The Sponge-Jet equipment consisted of an 85litre USA manufactured screw auger, media Feed Unit and a European drum style media sifter. This equipment was run from a standard 7.0 bar 6m3/min rotary screw industrial compressor with a built-in after-cooler.

The 85 litre unit holds up to five 11.4kg bags of Aero-Alox 320 media and provides 15 minutes continuous blast time between refills. For general operations Sponge-Jet recommends a 240 litre Feed Unit which will extend blast periods from 30 to 45 minutes.

During the de-painting program the blast pressure was adjusted over a range of 1.5 to 3.4 bar and the media feed pressure set at 3.0 to 3.5 bar to produce a flow of 3.0 to 3.6kg/min.

The nozzle angle was varied from 30 to 45 degrees to the work surfaces and the nozzle stand-off distance ranged from 150 to 250mm.

The work scope included de-painting three to seven coatings in one pass down to the metallic clad substrate - and selectively stripping paint layer-by-layer while leaving the primer coating intact. Both of these targets were achieved and eight different sponge-blast operators - with varying experience of the Sponge-Jet Sponge Blasting system - produced consistent and fully controllable results. A significant benefit of this program was that the fine feathered edge produced by Aero-Alox™ gives the paint shop specialists a useful additional timesaving facility when undertaking rapid local spot repairs on this and other metallic aircraft.

This Sea Harrier program also enabled BAE to test and perfect several additional shielding and masking techniques to prevent the ingress of Sponge Media material into the aircraft. These techniques employ a variety of readily available masking tapes produced by 3M and other manufacturers - plus a number of proprietary BAE in-house aircraft plugging and sealing methods which have proved adaptable and very efficient.

(8) Typical Cleaning Speeds

While the cleaning speed data for the Sea Harrier work has not been released yet by BAE - Sponge-Jet's in-house and extramural experience with Aero-Alox™ 320 on similar test materials shows that operators can achieve a selective stripping rate of 3 to 5m2/hr during maintenance work on the exterior aspects of metallic aircraft. This cleaning rate can be attained on primer, middle and top coatings across all military aerospace paint systems.

When removing loose or flaking coatings from aircraft fuel tanks and interior fuselage sections, experience in the UK and the US with Aero-Alox™ 320, indicates that users can anticipate cleaning rates of 7.0 to 16.0m2/hr on many operations.

(9) Composites Trials Using Aero-Alox™ 320

Over the past three years, BAE SYSTEMS Dunsfold, Materials Engineering & Test Department, has conducted numerous Sponge-Jet trials on a wide range of aerospace composite materials. The main thrust of this work has been geared towards providing a low-dust cost-effective tool for de-painting composites during maintenance and refurbishment work on modern fighter aircraft and peripheral components.

The results from BAE SYSTEMS - which are supported by data from Sponge-Jet in-house parallel testing programs on various composite materials - show that Aero-Alox™ 320 is capable of stripping paints layer-by-layer from military aircraft without causing damage to the woven substrate or underlying honeycomb materials.

BAE SYSTEMS has also used Aero-Alox™ 320 to successfully de-paint aircraft composite Radomes and this application is currently being researched and developed further at several BAE sites around the UK.

(10) Now And The Future

Today, the Sponge-Jet Sponge Blasting process provides aerospace maintenance and refurbishment specialists with a low-dust cost-effective tool which can be adapted for a broad range of cleaning and de-painting tasks on metallic and composite aircraft and peripheral components.

Our plans for the future include liaisons with third-party manufacturers to integrate the Sponge Blasting process with customers existing de-painting installations - and - to offer a suite of tailor-made automated Sponge Media material recovery and management systems.

We will also be researching and developing computer controlled blast nozzle manipulators and specialized containment systems to suit the needs of military aerospace and civilian airline maintenance markets.

And finally, while Aero-Alox™ 320 is proving a real winner across various market sectors, Sponge-Jet is listening closely to the specific needs of the aerospace industry and we are geared to develop and produce new types of media rapidly to meet your requirements.

Tony Wilks
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