Spectra Certified Media with CarbideClean®

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ABSTRACT

Many types of storage media have come and gone in the last few decades, but tape is still heavily in use because it is extremely reliable, and has evolved to meet changing storage needs. The latest evolution in tape comes from Spectra Logic: a tape media treatment technology that significantly improves tape performance.

INTRODUCTION

Each new generation of disk has threatened to eliminate the need for tape as a viable storage tier. Yet tape has survived and continues to thrive. This storage medium remains the highest in reliability, lowest in cost, lowest energy use, and has the longest lifespan.

Tape storage continues to maintain a data center presence due in a large part to the fact that its role has evolved over the years. Until approximately 10 years ago, tape was primarily used as a backup platform. Today, tape storage is still being used in backup, disaster recovery, and compliance solutions. However, two new areas of usage account for accelerating growth of tape in the data center:

*Two key uses for tape have emerged: **deep storage** (low-cost storage without immediate access) and uses by **vertical applications** such as the cloud services and social media.*

- Deep storage encompasses horizontal applications such as active file archive, low-cost NAS storage, and deep storage archive. Deep storage is extremely low-cost, power efficient and dense storage for data that does not require immediate access.
- Vertical applications such as Web 2.0, cloud services, big data, media and entertainment, oil and gas exploration, life sciences, federal and state government, and social media, among others, also play a large role in the growth of tape in the data center.

Collecting and analyzing information is essential to making good business decisions, and an increase in both has driven data repositories to sizes that once were maintained only by government and supercomputing environments. Recently, online data repositories of multiple petabytes, and even exabytes, have started to become commonplace in enterprise environments. The higher number of larger data repositories is driving new requirements for long-term mass storage solutions aimed at increasing efficiency, lowering costs and improving access. Essentially, these trends are driving the accelerating growth of tape.

TAPE USE IS EVOLVING

Both the horizontal tape growth applications and the vertical growth applications use tape differently from the historical backup application usage. This storage model typically writes to new tapes, storing data for constant access as well as long-term preservation. This strategy uses a Write Once Then Store (WOTS) mode of operation.

In support of such highly demanding applications, Spectra Logic has developed a new tool that improves tape drive and tape media reliability: media pre-cleaning using CarbideClean® technology.

Tape is Extremely Reliable

Tape is already extremely reliable. Shelf life for the media is guaranteed for 30 years. Data on tape is protected from many of the integrity issues that can affect disk: disgruntled employees, viruses and malware simply because it is offline.

Tape also has the best Bit Error Rate (BER). BER is the number of bit errors divided by the total number of transferred bits during a studied time interval. Bottom line BER is a measurement of data integrity.

Table 1: Disk and Tape Hard Error Rates[3]

Device	Hard error rate in bits	Equivalent in bytes	PiB equivalent
SATA consumer	10E14	1.25E+13	0.01
SATA Enterprise	10E15	1.25E+14	0.11
Enterprise SAS/FC	10E16	1.25E+15	1.11
LTO and some Enterprise SAS SSDs	10E20	1.25E+19	11102.23
Enterprise TS11xx Tape	10E21	1.25E+20	111022.2

CarbideClean Removes Particles to Further Enhance Tape Reliability

CarbideClean improves upon the already exemplary reliability of tape by removing particles.

Particulates, however pose an increasing risk to all storage technology, including tape, as ever greater amounts of data are stored in a tighter constrained space. With tape technologies, the distance between the tape drive head and the physical tape continues to shrink to support the increasing density of data written to tape. This decreasing tolerance increases the drive's sensitivity to debris that can separate the head from the media enough to interfere with the signal. Small particulates that would have had minimal or no effect on early generations of LTO or TS11XX Technology can now increase signal noise to unacceptable levels causing decreased throughput, decreased tape capacity and potentially decreasing the integrity of the data. Debris can also damage the drive head decreasing head life to as little as 1400 hours.

Figure 1 shows a small area of a recorded LTO tape. The slanted lines in the center contain servo data that is used by the drive to find the data tracks, which are located on either side of the servo band. The diameter of the particle in this illustration is less than 100 µm (less than the thickness of a sheet of copy paper). Owing to the high density of the recorded data on today's tape media a particle of this size can render hundreds of bits unreadable.

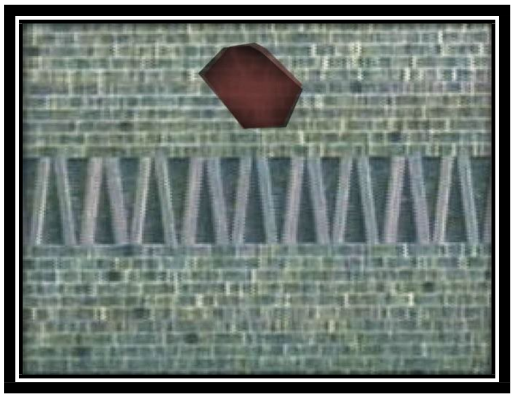

Figure 1: Tape media with a 100 µm particle

Debris is produced by the tape slitting process, the coating process, and head cleaning agents adding to the coating.

All new media has debris due primarily to the manufacturing process. There are several components of the process that contribute to the debris accumulation.

- The tape-slitting process involves slicing the large roll of coated media into strips about ½ inch wide and thousands of feet long. The slitting operation often leaves debris along the slit edge. Although the process includes removal of the edge debris, some remains trapped in the tape potentially impacting drive performance once the tape is used.

- The coating process is another source of loose debris. Some of this debris is dislodged only after use, typically after several passes BOT/EOT and back again.
- A third source of tape debris comes from the Head Cleaning Agents (HCA) that are added to the coating at the time of manufacture. These particles are contained in the magnetic coating layer. Over time, they can become dislodged and subsequently become trapped in the tape pack. HCAs are typically large compared to the required head-media separation distance, causing dropouts in data.

The CarbideClean Solution is Available ONLY From Spectra Logic

Spectra Logic saw the threat posed to tape storage systems by particulates— and is the only company to address the threat and find the solution. Spectra Logic collaborated with an independent storage engineering consulting firm to invent a new tape cleaning process aptly named CarbideClean.

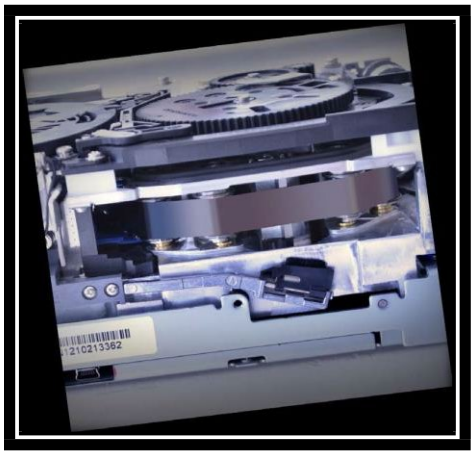

Figure 2: Spectra Logic CarbideClean drive

CarbideClean uses a carbide cleaning head to remove particulates prior to a tape's initial use. By first cleaning tapes that will be used in a WOTS fashion, debris is removed without requiring tape reuse. Only Spectra Logic's Certified Media offers multiple integrity and performance advantages—including this pre-cleaning technology.

CarbideClean Testing and Result Data

To validate the benefits of CarbideClean, Spectra designed and conducted specialized testing. The testing consisted of the following:

- Three LTO drives to write to LTO tapes that had not undergone CarbideCleaning (Control group)
- Three LTO drives to write to LTO tapes that were CarbideCleaned (CC group)
- A total of 6,600 tapes were tested (1,100 tapes per drive)

The test consists of the following steps:

1. A tape cartridge loaded into the drive
2. Two physical wraps of data written to the tape
3. Gathering of the log parameter data from the drive log pages to quantify performance

The log parameters measured are as follows:

- Total Write Time - the time that the write to tape took in milliseconds.
- Write Retries - incremented when an error is detected during Read- While-Write verification requiring the drive to rewrite the data set further down the tape.
- Suspended Writes - number of interrupts by a defect or disturbance that results in incorrectly written tracks ; the drive has to write the data set further down the tape.
- Media Efficiency - overall measure of the currently mounted media's condition (lower is better)

Summary of Results

The following sets of results were found after testing:

Total Write Time on average was 4 seconds faster for the CC group than for the Control group.
This translates into 160 seconds faster if writing the entire tape.

4 seconds per 2 wraps, 80 wraps on an LTO-5 tape Average 4 seconds * 40 = 160 seconds faster)

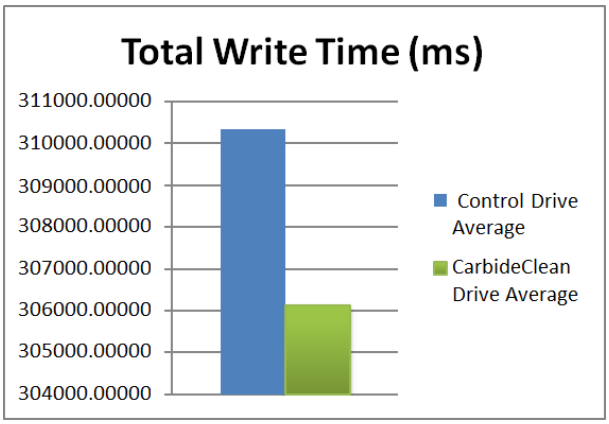

Figure 3: Total Write Time

Fewer write retries and suspended writes translate into better performance and higher capacity.

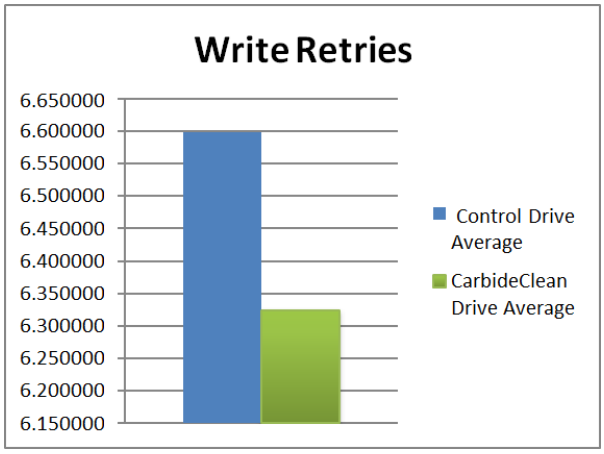

Figure 4: Write Retries

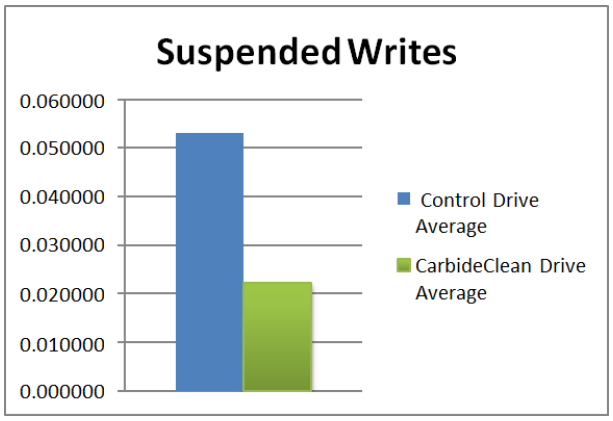

Figure 5: Suspended Writes

Media Efficiency scores, as rated by the tape drives, were on average lower for the CC group than for the Control group (5.46 vs. 6.34). Scores were on average 15% better for the CC group than for the Control group.

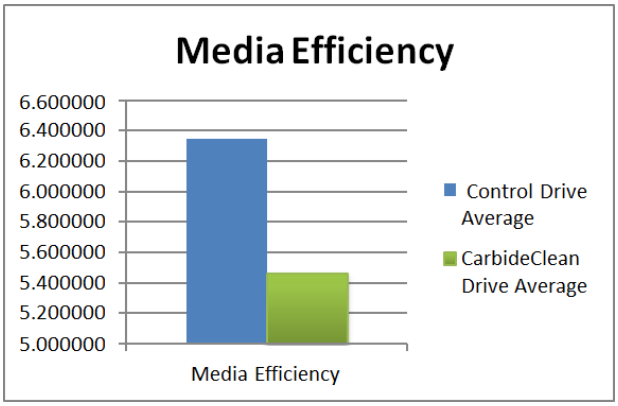

Figure 6: Media Efficiency

Additional Benefits of CarbideClean

In addition to this testing, the following effects of CarbideClean contributed to increasing the longevity of the drive tape head.

- Stearic Acid blooming on tape, resulting in a fine white powder, was cleaned from the media by the CarbideClean polisher drive.
- The CarbideClean process smoothed tape that was highly abrasive and would have resulted in excessive wear and tear on the tape head.

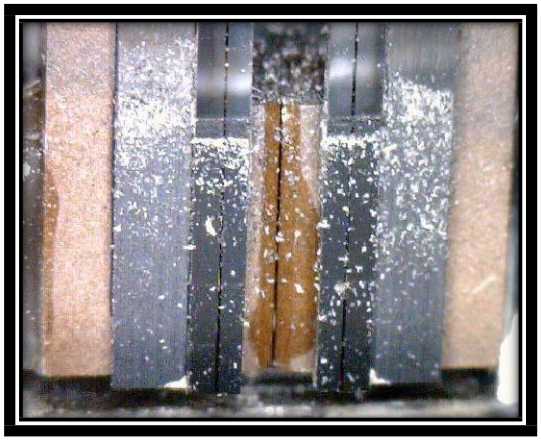

Figure 7: Stearic Acid blooming

CONCLUSION

With increasing reliance on tape, improving tape media reliability is very important, and achievable using CarbideClean.

Archive and deep storage requirements are changing how tape is used. At the same time, these applications demand even more of tape in terms of reliability, data integrity and performance. These demands have amplified the importance of cleaning the manufacturing debris from the media prior to the first use of the tape. Tape drive error rates, re-writes, and reductions in system throughput (transfer rate) are adversely affected by debris.[4]

Spectra Logic's Certified Media offers a multitude of features specifically designed to enhance the performance, capacity, data integrity and reliability of tape media. And like CarbideClean, they come free with the purchase of Spectra Media.

[4] How Contaminants Affect Tape Data Reliability at High Areal Densities, Applied Engineering Science, Inc., 2011

ABOUT SPECTRA LOGIC

Spectra Logic develops data storage and data management solutions that solve the problem of long- term digital preservation for organizations dealing with exponential data growth. Dedicated solely to storage innovation for 40 years, Spectra Logic's uncompromising product and customer focus is proven by the adoption of its solutions by leaders in multiple industries globally. Spectra enables affordable, multi-decade data storage and access by creating new methods of managing information in all forms of storage—including archive, backup, cold storage, private cloud and public cloud.

To learn more, visit www.SpectraLogic.com.

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