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The Relative Stabilities of Optical Disc Formats

by JOE IRACI

INTRODUCTION

The problem

In the early days of laserdisc and CD manufacture, a problem known as “laser rot” became evident. “Laser rot” is a term used to describe the corrosion of the metal reflective layer, which leads to its discolouration or pitting. This layer (see Fig. 1) is a very important component in the optical disc structure. Its role is to reflect the laser light of the player/drive back to the detector in order to create a signal.

Any damage to this layer will lead to improper reflection of the laser light and create reading problems if the error correction system associated with optical disc technology cannot compensate for the damage. Fortunately, the source of the problem that led to “laser rot” was discovered. It was determined the cause was a poor protective top layer that allowed atmospheric contaminants and other aggressive agents from enclosure materials, labels, etc. to attack the metal layer. The use of better coating techniques and more impermeable lacquer layers that covered the top and edges of the disc completely solved this problem. However, metal layer corrosion can still be encountered in cheaper discs due to the use of poor quality materials or poor manufacturing techniques. Therefore, the longevity of optical discs is a concern for users of these information carriers.

Current opinions

There are contradictory opinions in the sparse literature and research or from individuals’ own experience when it comes to the longevity of optical discs. The disc manufacturers have generated most of the longevity data presented in the literature. There are few independent studies and yet plenty of anecdotal evidence. For example, some have claimed that CD-R discs have failed within five years. On the other hand, some manufacturers claim lifetimes of 100 to 200 years. A similar situation exists for other optical disc formats. Unfortunately, for those considering the use of optical discs for archival storage of information, these broad longevity ranges are not very useful.

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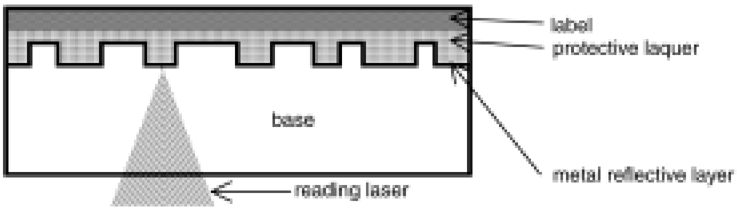

Fig. 1: A cross-section of a read-only or stamped CD such as an audio CD).

Test methods

In order to help shed some light on this problem, three standard test methods have been developed[1–3]. These are used to determine the life expectancy of three different types of optical discs based on the effects of temperature and relative humidity. Estimated longevities are determined with the Eyring acceleration model. Discs are exposed to five different temperature and relative humidity conditions and the survival population at a preselected end-of-life point is determined. Lifetime values are calculated from these data. Eighty discs of one type need to be tested and one of the aging conditions requires six months. Obviously, an extensive amount of time and resources are required to arrive at a lifetime estimate for one disc brand. Furthermore, optical disc products change regularly to suit the consumer. For example, writing speeds for recordable and erasable media are constantly increasing, sparking changes in disc formulations. Therefore, extensive studies to estimate longevity values for a particular product may not be useful.

A new approach

The approach taken in the current study does not attempt to make longevity value predictions as in the standard test methods, but is similar to approaches used in other studies[4–11]. Aging at a fixed temperature and relative humidity (80°C and 85% RH) and then measuring the proportion of discs that fail at given time intervals is the technique that is used to determine the relative stability of various types of discs. Interpretation of these data is dependant on a number of assumptions about the chemistry of the degradation. Firstly, it is assumed that degradation is accelerated proportionately for all discs, and that the same order of failure will apply at lower temperature as at the higher temperature. Thus it is assumed that if Disc A survives better than Disc B at high temperature – it will also do so at lower temperature. Implicit in this is another assumption, which is that the reactions being accelerated at the higher temperature are the same as those that would normally occur at room temperature.

A similar approach is used in a Kodak white paper[11], where the assumption is made that the longer the media survives under the aging conditions, the more stable the discs will be under recommended storage conditions. Despite the assumptions, this type of aging provides useful guidance on the relative longevity of discs. But, as mentioned above, conclusions are subject to product changes. However, in this study, the results are based on a group of discs representing a disc format rather than a single brand. Each group of discs tested incorporated different brands obtained over a two to three year period. This captures changed that had occurred with product lines (i.e. speed change).

EXPERIMENTAL

Samples

A variety of CD and DVD samples were tested (cf. Table 1).

- Audio CD: Used commercial audio CD discs were purchased. The discs were cleaned prior to testing.
- DVD. New commercial DVD movie discs were purchased for testing.
- CD-R and CD-RW. For the CD-R and CD-RW samples, an audio track was repeatedly recorded onto the discs until they were full. It was determined that for most brands, the 4x recording speed produced discs with the lowest error rate and therefore, this speed was chosen to record the majority of discs.
- DVD-R and DVD-RW. Movie clips were recorded onto the DVD-R and DVD-RW samples at 2x until the disc capacity was reached.

Testing of discs

Discs were evaluated before aging and after each aging interval. CDs, CD-Rs and CD-RWs were evaluated with a Clover Systems QA-101 triple beam analyser at 2x speed. DVDs, DVD-Rs and DVD-RWs were tested with a CD Associates DVD200MG Plus DVD analyser.

After examining each parameter measured by the testing device, average Block Error Rate (BLER) was chosen for the analysis of the CD, CD-R, and CD-RW samples. BLER is defined as the number of data blocks per second that have errors at the first stage of error correction. It is a sensitive measure of change oc-

Table 1: The number and types of discs studied.

Disc Type or Brand	Metal Layer Appearance	Capacity	Speed	No. of Discs Tested
CD				
A variety of used audio CD's				24
CD-R - phthalocyanine dye				
Smart Buy	silver	700MB	1x-16x	4
Memorex (black)	silver	700MB	1x-16x	4
Imation	silver	700MB	1x-24x	4
Maxell	silver	700MB	1x-24x	4
Nashua	silver	700MB	1x-48x	4
Sony	silver	700MB	1x-48x	4
Memorex	silver	700MB	1x-48x	4
Kodak	gold	650MB	multi	4
CD-R - cyanine dye				
Unknown	gold	650MB		4
Acer	silver	650MB	multi	4
Imation	silver	650MB	1x-4x	4
TDK	silver	650MB	1x-6x	4
Fuji	silver	700MB	1x-16x	4
Sony	silver	700MB	1x-32x	4
Mitsumi*	silver	700MB	1x-48x	4
Cicero*	silver	700MB		4
CD-R - azo dye				
Verbatim	silver	650MB	1x-8x	4
Verbatim	silver	700MB	1x-16x	4
Verbatim	silver	650MB	1x-24x	4
Verbatim	silver	650MB	1x-32x	4
Verbatim	silver	700MB	1x-48x	4
CD-RW				
Systemax		700MB	1x-4x	4
Fuji		650MB	1x-4x	4
Memorex		700MB	1x-4x	4
TDK		700MB	1x-4x	4
Verbatim		650MB	4x-10x	4
Hypermedia		650MB	4x-10x	4
Imation		650MB	4x-10x	4
Sony		650MB	4x-10x	4
Maxell		650MB	4x-10x	4
HP		700MB	4x-12x	4
DVD (read-only movie discs)				
Single-sided/single-layer (DVD-5)				19
Double-sided/single-layer (DVD-10)				11
Single-sided/double-layer (silver appearance through base) (DVD-9)				9

Table 1, continued.

Brand	Dye Appearance	Version	Capacity	Speed	No. of Disks Tested
DVD (read-only movie discs); continued					
Single-sided/double-layer (light gold appearance through base) (DVD-9)					12
Single-sided/double-layer (gold appearance through base) (DVD-9)					16
DVD-R (single-sided/single layer)**					
Fuji	blue	v2.0	4.7GB		4
Imation	blue	v2.0	4.7GB		4
Sony	blue		4.7GB		4
Maxell	blue	v2.0	4.7GB	2x	4
Mitsui	blue	v2.0	4.7GB		4
TDK	blue	v2.0	4.7GB	2x	4
Verbatim	mostly blue	v2.0	4.7GB		4
E3 Works	light blue		4.7GB	4x	4
Cursor	purple/brown	v2.0	4.7GB		4
SmartDisk	purple		4.7GB		4
DVD-RW (single-sided/single layer)***					
Fuji		v1.1	4.7GB		4
Maxell		v1.1	4.7GB		4
Verbatim		v1.1	4.7GB		4
BMI			4.7GB		4
Lead Data			4.7GB	2x	3

* Samples delaminated during the first aging interval and could not be analysed.

** One other brand was considered for testing, but could not be analysed properly prior to aging.

*** Three other brands were considered for testing, but the samples could not be recorded or analysed properly prior to aging.

curring with the disc. However, if a disc has a high BLER value, it is difficult to determine the precise source of the problem because it is only a general indication of disc quality. This is because a number of elements can contribute to a rise in BLER.

For the DVD, DVD-R, and DVD-RW samples, the average PI (Parity Inner) value was chosen for the analysis. As stated in the Operating Manual[12] for the DVD200MG Plus DVD analyser, "*this error parameter is the only digital error rate actually specified in version 1.0 of the DVD spec. The specification states that the number of PI rows containing any bad symbols, summed over any eight consecutive ECC Blocks, should be less than 280*." In short, it is the equivalent of BLER.

For the CDs, the Audio CD Red Book[13] limit for BLER was used. The Red Book is the standard for the audio CD and contains all the technical specifications.

The standard states that the BLER must be less than 220 per second. Standards such as ISO/IEC 10149[14] and ISO 18921[1] also use this figure. In this study, a change in average BLER greater than 220 was taken as the failure point or end of life of the disc. The PI limit of 280 as specified in Version 1.0 of the DVD specification was used for the DVDs. A change in average PI greater than 280 was taken as the failure point or end of life of the disc.

Aging conditions

The samples were aged in controlled temperature and humidity chambers (ESPEC PRA-3GP) at 80°C and 85% RH for four intervals of 500 hours (21 days). The total aging time was 2000 hours (84 days). This is the harshest aging condition outlined in the aging standard[2] and this condition has been used in previous studies. Since the aim was not to produce an Arrhenius type study (so that extrapolation could be made to predict lifetime values), the discs were aged at the harshest conditions to ensure that degradation would occur within the aging period, thus allowing a ranking of the discs in terms of stability. At the beginning and end of each aging interval, the discs were allowed to adjust slowly to the new conditions of temperature and humidity as indicated in the aging standard[2]. This was required to allow the substrate to equilibrate to the changed environment, preventing the formation of liquid water droplets inside the disc structure, curvature of the disc, and possible delamination of disc layers.

RESULTS AND DISCUSSION: DEGRADATION UNDER ACCELERATED AGING

This study was performed to determine which discs would degrade under accelerated aging conditions and to examine how they degraded in order to determine where the weaknesses resided with the various formats. The results that follow focus on macroscopic change and a brief discussion about how the error rates of the discs changed with aging.

CDs (Read-only audio)

Of the 24 audio CDs that were tested, 14 (58%) showed no visible changes at the end of the 84-day aging period. Six of the discs (25%) showed some minor localized delamination of the top layers (label, lacquer, and metal layer) as illustrated in Fig. 2.

Fig. 2: Audio CD showing small areas of delamination after 84 days of aging. The label, lacquer and metal reflective layers have delaminated in these areas.

Fig. 3: An audio CD (viewed through the base side) after 84 days of aging. The metal layer has been attacked and is nearly transparent. The label on the other side of the disc can be easily read.

This delamination is likely caused by the harsh aging conditions in conjunction with poor disc manufacturing which produced discs that could not tolerate the non-ideal conditions. The remaining four discs (17%) all experienced an effect similar to the "laser rot" phenomenon (severe thinning of the metal reflective layer and/or severe pitting) as shown in Fig. 3.

This value of 17% compares well with estimates and anecdotal reports in the literature where the percentage of discs experiencing similar problems seems to be in the 10% to 20% range[15].

In terms of average BLER values, 38% of the discs experienced a change less than 220 and 62% could still be analysed to completion (even though the 220 limit was exceeded) after 84 days of aging.

CD-Rs (Recordable CDs)

The three main types of dyes that are used with recordable CDs are phthalocyanine (light green), cyanine (shades of blue), and azo (shades of blue). Each dye provides discs with unique characteristics, one of which is stability. According to information from manufacturers and the literature, the phthalocyanine dye is more stable towards light and heat than the other two.

Visible effects caused by the accelerated aging were limited to some delamination problems and fading of the dye colour. Grouping the discs together (all dye types), 13 out of 84 discs (15%) experienced delamination of the disc layers (see Fig. 4).

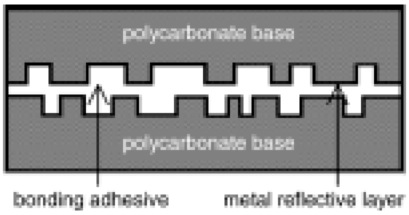

Fig. 5: A cross-section of a DVD read-only disc. This is an example of a double-sided/ single-layer disc.

Fig. 4: An example of the delamination of layers in a CD-R (recordable CD) after only 21 days of aging.

As mentioned previously, this is likely due to the harsh aging conditions in combination with poor disc manufacturing. Dye fading (monitored by visual inspection) occurred with the discs containing the cyanine or azo dye. Of the 32 discs with the cyanine dye, 25% produced severe fading of the dye layer. For the azo dye discs, 60% of the 20 discs tested showed severe dye fading, whereas the remaining discs experienced darkening of the dye with aging.

In terms of error rate changes, 72% of the phthalocyanine discs experienced a change in average BLER of less than 220 and 84% could still be analysed to completion after 84 days of aging. In fact, a majority of discs had a very low change in average BLER (<20). Discs with the cyanine dye did not perform as well. Only 4% of the discs did not suffer an average BLER change of greater than 220 and only 20% of all the discs tested could be analysed completely to the end of the disc after 84 days of aging.

No discs using the azo dye changed by less than 220 in average BLER and also no discs could be analysed completely to the end of the disc without stopping after 84 days of aging.

These results illustrate the superior accelerated aging stability that CD-R discs with the phthalocyanine dye have over those using the other dye types. The results also support the accelerated aging studies that have been performed by manufacturers of discs using this dye type[16,17].

CD-RWs (Erasable CDs)

Ten brands of CD-RW discs were tested. No discs experienced delamination of layers and only two brands of discs (20%) experienced some sort of visible damage to either the metal layer or phase change recording layer of the disc.

After 84 days of aging, only 12% of the discs changed by less than the average BLER limit of 220. However, 35% of the discs could be analysed completely to the end without problems.

DVDs (Read-only movie discs)

Although similar in appearance, DVDs differ from CDs in several important structural ways. First, a DVD is two discs (the same diameter as a CD disc, but half the thickness) bonded together as shown in Fig. 5.

One of the major concerns about the longevity of DVD discs is the failure of the bonding layer leading to separation of the DVD disc into two halves. There has been anecdotal evidence of this occurring, but currently there is not enough information to conclude whether this is a significant problem. Other major differences between a DVD disc and a CD are that a DVD can have more than one information layer on one side and the disc may also be double-sided. Because a variety of DVD structures exist, the discs in this study were placed into five categories as follows:

- single-sided/single-layered,
- double-sided/single-layered,
- single-sided/dual-layered (silver appearance when viewed from the base side),
- single-sided/dual-layered (light gold appearance when viewed from the base side),
- single-sided/dual-layered (gold appearance when viewed from the base side).

DVDs having two layers on one side of the sandwich may have a gold or silver appearance on the non-label side. This indicates the type of metal used for the reflective layer. Gold, silicon, silicon carbide , silicon nitride, or silver alloys are used for the semi-reflective layer (the layer closest to the reading laser or base of the disc) and silver alloys or aluminum are used for the second fully reflective metal layer.

None of the DVDs tested after 84 days of aging showed any signs of failure in the adhesive bonding the two halves of the discs together. Nor were any delamination problems encountered. However, many of the discs had significant visible deterioration as a result of the aging. A total of 57% (38 discs) showed problems such as pinholes in the metal layer(s), thinning, complete disappearance, discolouration, or streaking of the metal layer(s) and a variety of other blemishes. Examples of some of these effects are presented in Fig. 6.

For the single-sided/dual-layered discs, it was difficult to determine if one or both of the metal layers were affected and thus, difficult to approximate how

Fig. 6: DVD read-only discs (movie discs) with visible deterioration as a result of accelerated aging. The view of the discs is through the base side.

A: Three examples of a thinning or complete disappearance of the metal reflective layer

B: Two examples of pinholes in the metal reflective layer.

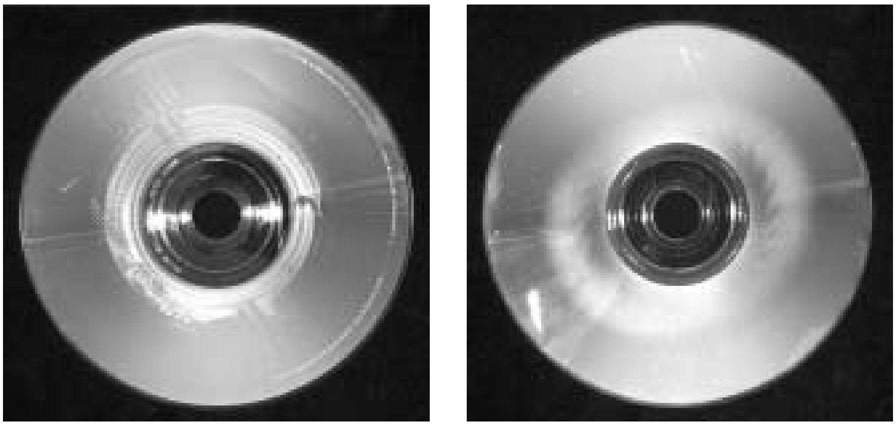

Fig. 6: DVD read-only discs (movie discs) with visible deterioration as a result of accelerated aging. The view of the discs is through the base side.
C: Other blemishes caused by accelerated aging.

many discs suffered a “laser rot” type of phenomenon with aging. However, some numbers can be estimated. Of the 67 DVD discs aged, 18 (27%) suffered obvious pitting or complete or near complete disappearance of the metal reflective layer. This is more than anecdotal estimates of about 1% to 10% of discs beginning to show some sort of “laser rot” problem[18]. Twenty discs (30%) had a discolouration or streaking of the metal layer. If this is also “laser rot”, then it is possible that up to 57% of all discs suffered a “laser rot” type problem with the metal reflective layers.

The error analysis of the aged discs is provided in Table 2. It illustrates that only a small percentage of discs survived the aging. Grouping all the discs together results in only 7% with an average PI change less than 280 and 12% that could be analysed completely without interruption after 84 days of aging. This is a significantly lower percentage than the numbers for the audio-CDs where the figures were 38% and 62% respectively.

DVD-Rs (Recordable DVDs)

Ten brands of single-sided/single-layered DVD-R discs were tested. Most discs were blue in appearance when viewed by the base side, but two were purple. It is suspected that either cyanine or azo dyes are being used in these discs; phthalocyanine is a very light green almost colourless dye. For the analysis, all the discs were grouped together.

Table 2: PI analysis of DVD movie discs aged for 84 days.

	Percentage of discs with change in average PI less than 280	Percentage of discs that could be analysed to the end without interruption
Single-sided/single-layer	5	16
Double-sided/single-layer	27	27
Single-sided/dual-layer (silver)	0	0
Single-sided/dual-layer (light gold)	0	8
Single-sided/dual-layer (gold)	6	6

Most of the aged DVD-Rs showed minor changes in the dye colour with aging. Two brands experienced significant fading, whereas another brand experienced irregular results (fading and darkening) from disc to disc. Only one disc brand suffered from delamination of the label adhered to the top of the disc. This did not lead to loss of the disc or performance problems. No delamination of the DVDs due to failure of the bonding adhesive was encountered.

Only 8% of the discs tested experienced a change in average PI of less than 280 and could be analysed without problems after 84 days of aging. This indicates a significant amount of change and does not correlate well with the visual observations. It is possible that the dark colour of the dye masks deterioration of the metal reflective layer.

DVD-RWs (Erasable DVDs)

Five brands of DVD-RW discs were examined. No delamination problems were encountered. With aging, one brand appeared to have formed bubbles within the disc structure. After only 42 days of aging, no discs showed a change in average PI less than 280 and no disc could be analysed completely without problems.

RESULTS AND DISCUSSION: RELATIVE STABILITY OF DISCS

Another reason for performing this study was to compare the relative stability of discs in order to provide useful information for those interested in their archival potential (or lack of it).

Table 3 lists all the samples that were tested and gives the percentages of discs with error rate changes less than the limits of 220 for CDs and 280 for DVDs after each aging interval (called survival percentage). Such discs are still considered usable.

Table 3: Percentage of discs with a change in average BLER less than 220 for the CD samples and average change in PI less than 280 for the DVD samples.

	Aging (days)				Rank after	Overall
	21	42	63	84	84 days	rank*
CD-R (phthalocyanine dye)	97	81	75	72	1	1 (4)
CD (audio)	75	67	54	38	2	2 (9)
DVD (movie); double-sided/single layer	54	27	27	27	3	3 (18)
DVD (movie); single-sided/dual layer (gold)	81	56	12	6	6	3 (18)
DVD-R; single-sided/single layer	50	37	18	8	5	5 (22)
CD-RW	38	22	20	12	4	6 (26)
DVD (movie); single-sided/dual layer (light gold)	75	25	0	0	9	7 (28)
DVD (movie); single-sided/single layer	42	26	16	5	7	7 (28)
CD-R (azo dye)	75	0	0	0	9	9 (32)
DVD (movie); single-sided/dual layer (silver)	56	11	0	0	9	10 (34)
CD-R (cyanine dye)	20	12	12	4	8	11 (36)
DVD-RW	21	0	0	0	9	12 (40)

* Overall rank is based on the sum of the ranking for each aging interval. For example, the phthalocyanine discs aged the best in each aging interval and therefore were given a value of 4 (1+1+1+1).

Ranking the discs solely on performance after 84 days of aging can be misleading. For example, CD-R azo discs are ranked the same as DVD-RW discs after 84 days of aging. However, after 21 days of aging the CD-R azo discs had a much better survival percentage (75% compared to 21%). Therefore, the overall ranking, based on performance after each aging interval, is a better indicator of aging performance.

As is evident from Table 3, the format with the highest survival percentage is the CD-R with the phthalocyanine dye. In fact, close to three quarters of the discs tested (which is nearly double the amount of discs as compared to the next ranked format) survived 84 days of rather harsh aging conditions. These are interesting results considering that only one of the eight brands tested had a gold metal reflective layer, a requirement considered essential for optimum longevity. The benefits of the inert gold layer would likely be more evident in polluted atmospheres, storage in poor quality enclosures, etc. In these experiments, it is suspected that the silver alloy reflective layer performed well because only the effects of tem-- perature and relative humidity were examined. It is not known if similar results would be achieved in a less sterile environment. Testing done elsewhere has shown the vulnerability of the silver metal reflective layer to polluted environments[19].

The CD-R phthalocyanine group had a higher survival percentage than all other recordable CD-Rs. CD-R azo and CD-R cyanine both performed very badly under these aging conditions. CD-RWs, which did not fare as well as CD-R phthalocyanine, did show a better survival percentage than the CD-R azo or cyanine discs. Once again the claim made by manufacturers and several experts that discs with the phthalocyanine dye are the best CD-Rs to choose when longevity is a requirement is validated. The phthalocyanine CD-Rs also performed very well in comparison with the DVD-R and DVD-RW discs. The DVD-RW discs performed very poorly (worse than any other disc format) and worse than the comparable CD-RW format. This could be due to differences in the composition of the phase change erasable layer or effects from the bonding adhesive that was used. The DVD-R discs performed much better than the DVD-RW discs and in fact better than the CD-R azo and CD-R cyanine discs. The DVD-R discs tested in this study use some form of the cyanine or azo dyes. Therefore, it was expected that the stability of the DVD-R discs would not be as good as the CD-R phthalocyanine discs, but it is a little surprising that there was such a difference between the DVD-R and the CD-R azo and cyanine formats.

The second ranked samples were the CD-audio discs. Considering the concern about "laser rot" these discs were not expected to show a higher survival percentage than most of the other disc formats. However, the overall quality of these discs seemed to be better than generally believed and perhaps it is true that the "laser rot" phenomenon is limited to only very early samples and poorly manufactured present day samples. Poor handling and storage practices are responsible for many of the problems that occur and often have been mistakenly interpreted as poor chemical stability.

The stability of the DVD movie discs varied depending on the type of disc and the type of metal reflective layer used. The double-sided/single-layered discs ranked third highest and showed better stability than the single-sided/single-layered discs. It was expected that these two formats would behave similarly because outside of having one extra data layer, the discs are similar, likely using the same type of metal reflective layer and bonding adhesive. One possible explanation is that several of the single-sided/single-layered discs tested were very cheap (in price) which is a reflection of the content, but may also be a reflection of manufacturing quality.

As for the single-sided/dual-layered discs, the discs with the gold appearance ranked higher than the other discs. The light gold discs ranked in between the gold and silver discs. It appears that stability is linked to the colour (type of metal layer) that was used.

The CD audio discs had a better survival percentage than the DVD movie discs. The comparison is a little difficult because of different measuring systems, but the aging has shown more reactivity with the DVD discs. Further investigation is ongoing to determine the cause of DVD disc instability.

CONCLUSIONS

The disc format with the best survival percentage is the CD-R using the phthalocyanine dye. If longevity is a requirement when selecting a disc format, then the CD-R with phthalocyanine dye is a better choice than the other available CD or DVD formats. The silver metal reflective layer performed well, but if the environment is less than ideal, then a gold metal reflective layer will provide better stability. The one drawback is that the maximum capacity of the CD-R is only 700MB. This is a major problem for some, since collections of digital information are exponentially increasing in size. The DVD-R format currently provides about 4.7GB of storage (about 7 times more), but as illustrated in this study the DVD-Rs currently being produced are not showing the stability of the CD-R phthalocyanine discs. It is hoped that if the phthalocyanine dye is used for DVD-Rs in the future, then the discs will show the excellent aging stability of their CD-R counterpart.

SUMMARIES

The Relative Stabilities of Optical Disc Formats

There is a lot of uncertainty about the stability and longevity of optical disc formats. Manufacturers of these products do provide some data to support the long lifetime claims that they make. However, there is also anecdotal information indicating short lifetimes for optical discs. This leads to confusion for individuals or organizations looking at possibly choosing optical discs for the archival storage of information. The purpose of this study is to help eliminate the confusion on the stability and relative longevities of optical disc formats. The focus of this research was not to determine lifetime values for individual disc brands. Instead, a variety of optical disc formats (audio CDs, CD-Rs, CD-RWs, DVD movie discs, DVD-Rs, and DVD-RWs) were subjected to accelerated aging at 80°C and 85% relative humidity in order to determine if and how these formats degraded. In addition, a relative stability ranking of the various optical disc formats was determined.

La relative stabilité des différentes cibles de mémoire optiques (CD, DVD)

Une grande incertitude règne en ce qui concerne la stabilité et la longévité des cibles de mémoire optiques. Les fabricants de ces produits fournissent certaines données qui permettent de supposer une longue durée de vie. Cependant certaines informations anecdotiques mentionnent une courte durée de vie pour les mémoires optiques. Ceci prête à confusion pour les personnes concernées, particuliers ou organisations cherchant à trouver un moyen adéquat pour stocker à long terme l'information. L'objet de cette étude consiste à essayer d'éliminer la confusion relative à la stabilité et à la longévité des cibles de mémoire optiques. Il ne s'agit pas de déterminer des périodes de durée pour certaines marques de produits. Mais plutôt toute une série de ces pro-

duits (Audio- CD, CD-R, CD-RW, DVD Film-Disc, DVD.-R, DVD-RW) ont été soumis à un vieillissement accéléré à 80°C et 85% d'humidité relative afin de constater si et comment chacun de ces objets avait souffert de ce traitement. Ensuite on a pu déterminer l'ordre et l'étendue des dommages subis par chaque objet.

Die relative Haltbarkeit verschiedener optischer Speicherplatten (CD, DVD)

Bezüglich der Dauerhaftigkeit optischer Speichermedien herrscht weithin Unsicherheit. Zwar stellen die Hersteller Daten zur Verfügung, welche die Annahme einer hohe Dauerhaftigkeit stützen, jedoch gibt es auch gelegentliche Hinweise auf eine niedrige, was zu Unsicherheit bei Personen und Institutionen führt, die nach einem optischen Speichermedium suchen, das für die Langzeitarchivierung von Daten geeignet ist. Ziel der Studie ist es, zur Verminderung dieser Unsicherheit beizutragen. Es geht nicht darum, Zeiträume der Dauerhaftigkeit für einzelne Herstellermarken zu bestimmen. Es wurden vielmehr eine Reihe solcher Produkte (Audio-CD, CD-R, CD-RW, DVD Film-Disk, DVD-R, DVD-RW) einer beschleunigten Alterung bei 80°C und 85% rF ausgesetzt, um festzustellen, ob und in welcher Weise die einzelnen Objekte Schaden erleiden. Sodann wurde die Reihenfolge des Ausmaßes der Schäden an den einzelnen Objekten ermittelt.

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Joe Iraci
Senior Conservation Scientist
Canadian Conservation Institute
1030 Innes Road
Ottawa, Ontario, Canada
K1A 0M5
Tel.: (613) 941-4991
Fax: (613) 941-4994