COLLAB HOUR

Weekly Webcast for Members

BREWERS ASSOCIATION

Understanding the Science of Your Brew

AND ITS IMPACT ON FLAVOR QUALITY & PACKAGING

sponsored by ThermoFisher SCIENTIFIC

The world leader in serving science

Dr. Glen Fox

Anheuser-Busch Endowed Professor of Malting and Brewing Sciences

University of California, Davis

Dr. Gary Spedding

Owner & Analytical Chemist

Brewing and Distilling Analytical Services

Understanding the Science of Your Brew and Its Impact on Flavor Quality and Packaging

Glen Fox

Anheuser-Busch Endowed Professor Malting & Brewing Science

Understanding the Science ……..

Quality!

- What is your definition of quality?
- What is your quality control program?
- All in-house?
- Outsource some validation testing?

Understanding the Science ……..

Do you really understand the science of brewing and it's impact on flavor quality and packaging?

- Raw materials (4 at least)
  - Malt quality (grain quality)
  - Hop quality
  - Yeast quality
  - Water quality

All contribute to flavor but how many flavor compounds in finished beer?

Understanding the Science ……..

Malt

- Malt Certificate of Analysis
  - Moisture
  - Extract (soluble material: It than just sugars!)
  - FAN (amino acids but not proline!)
  - Color (always lighter than in the brewhouse)
  - Diastatic power (enzyme to produce fermentable sugars)
  - ?
  - ?

Malt Analysis

Moisture, %	4.08
Extract %, finely ground malt, as is	79.0
Extract %, finely ground malt, dry basis	82.3
Extract %, coarsely ground malt, as is	78.0
Extract %, coarsely ground malt, dry basis	81.4
F/C Difference %	1.0
Color, laboratory Wort, ASBC method	1.91
Viscosity	1.44
Beta Glucan, ppm	61
Diastatic Power	129
Alpha Amylase (DU)	65.4
Free Amino Nitrogen (mg/L)	211
Total Soluble Protein %, dry basis	5.32
Total Protein %, dry basis	11.47
S/T Ratio %	46.4
Friability	89.9
Homogeneity	98.9
Whole Kernel	0.3

Tyler Schoales & Mike Heinrich
Breakdown of a malt CoA

BA BREWERS ASSOCIATION

Understanding the Science ……..

Composition of barley

- Starch (60%)
- Protein (12%)
- Non-starch polysaccharides (5%)
- Phenols and polyphenols (2%)
- Lipids (2%)
- Vitamins (<1%)
- Minerals (<1%)
- Other (?)

What's modified during malting?

Participants or passengers?

Where does the flavor come from?

Understanding the Science ……..

Some basic perceptions about malt

- Color
- Flavor
- Aroma
- Sugars
- Amino acids
- Proteins for foam
- ?

Any risky compounds?

Understanding the Science ……..

Malt flavor

- How many flavor compounds?
- Maillard reactions (amino acids and sugars)
    - Maybe 400 Maillard compounds
- Strecker compounds (aldehydes)
    - Risks with flavor instability

Understanding the Science ……..

Hops

- Bitterness (alpha acids)
- Aroma (? compounds)
- Proteins (yes, hop cones have proteins)
- Amino acids (yes, hop cones contribute amino acids)
- Phenols and polyphenols (yes similar chemicals to barley)
- Starch and sugars

Understanding the Science ……..

Flavor and aromas

- How many compounds?
- Sensorial assessment
- Changes in hop processing
- Changes during brewing

Understanding the Science ……..

Yeast

- Alcohol
- CO_2
- Flavor compounds
- Aroma compounds
- Proteins in finished beer

Understanding the Science ……..

Basic Testing

- Gravity
- ABV
- pH
- Color
- DO
- TPO?
- Micro?

Additional Testing

- IBU
- Total polyphenols
- Amino acids
- Non-fermentable sugars
- Micro?
- Titratable acidity

Understanding the Science ……..

When to test

Prepackaging vs post packaging

- Will flavor change in the package?
- What is changing?
- Quality

Understanding the Science ……..

Validation

- Confirmation of your theoretical calculations
- Testing non-typical traits
- Pre-empting issues
- Spending $100s even month or so, could save $1000s in the long run

Beer in Cans? Quality Control Issues & Considerations

BA Seminar: 2022

Gary Spedding, Ph.D. BDAS, LLC.

Understanding the science of your brew and its impact on flavor quality and packaging.

Overview

In 1991 A paper appeared dealing with can issues, metal content and flavor during storage of Lager Beer.

Little has been presented directly on the topic for brewers since.

That Lager Paper?

Changes in Flavour and Metal content of Lager During Storage.
Griffiths, N. M. J. Inst. Brew. Vol 97: 173-179. 1991.

Exptl:

Lager > Glass Bottles, Steel and Al. Cans.

Fe, Al tested 0,1,3,4,6,9, & 12 mo.

All canned samples >> increases in **cabbage notes**/decreases in fruity, buttery & aromatic attributes. Bottles no similar trending.

Iron content < 0.03 mg/L (detection limit) in all packages up to 3 mo.

From 4 mo., on, **iron content** in 2 batches **steel cans** varied markedly from can-to-can – & average increases to 1.43 mg/L after 12 mo. storage.

Aluminum levels in bottles & **both types of can** (Iron & Al) **stayed below detection** levels of 0.1 mg/L.

That Lager Paper - II

Types of liner (epoxy shields) and integrity studies. The amount of metal exposed per metal can was determined.

Only flavor was really considered in such work.

Individuals sensitive to metallic notes might find objectionable lagers in steel cans stored over a length time (with steel cans with steel or Al ends).

Oxygen and staling factors were considered.

So, it would seem Al cans might be better for flavor/overall product stability – BUT are they?

LET'S MOVE ON THIRTY YEARS…

AND NOW

Miami Herald

Coronavirus News Sports Business Personal Finance Public Notices

RECALLS

Coors, Keystone beers 'voluntarily withdrawn' (recalled). 'Gelatinous' consistency noted

BY DAVID J. NEAL

UPDATED JUNE 16, 2022 9:18 AM

A can of Coors Light DAVID J. NEAL dneal@miamiherald.com

The Yeast handbook Springer-Verlag 2006 Ch. 11 Malcolm Stratford

Fig. 11.1. "Blown" packages of food or beverages represent the most obvious sign of yeast spoilage. This soft drink was inoculated with *Zygosaccharomyces bailii* before capping. Similar cans of beverage distended, ruptured or exploded between 1 month and 2 years

Have you got a handle on the can? Can you survive a recall?

A move to Al cans and New Liners

Cutting to the chase:

Little work done on newer types of beverage – e.g., sour beers in cans done.

Brewers got comfortable with brewing trad. style beers and putting them in cans – Mainly!

Sure, some haze, gushing/over-foaming issues were seen, but few complaints.

Today – Poor end cap seals, buckled ends, pin-prick leaks, exploding/exploded cans, severe gushing, product color changes, **sulfury aromas/flavors**, can liner degradation –chunks in the beer – yummy!

& more.

SO, WHAT GIVES?

Industry issues

Lack of QC.

We never had issues before, so we are OK.

But can liner changes and the chemistry of the products that are going into the cans.

No one doing forced testing – either in house (Simple tests) or the Can manufacturers – No longer their issue?

SO, POSING Q's.

So, will it eat me?

Run QC tests to see if chunks of liner break off. We see great chunks of plastic-like/”cellophane-like” or gelatinous matter in canned beers from time to time.

Store beers cold/warm vs. controls and see what happened to beer upon pouring, and then slice the can open and look inside.

Sediments, hazes, floc, matter in the base, pin-prick leaks, odd sulfur notes, gushing beers, flavor issues?

What could these be due to?

No QC guides really exist for this – Secrets of the Can manufacturers?

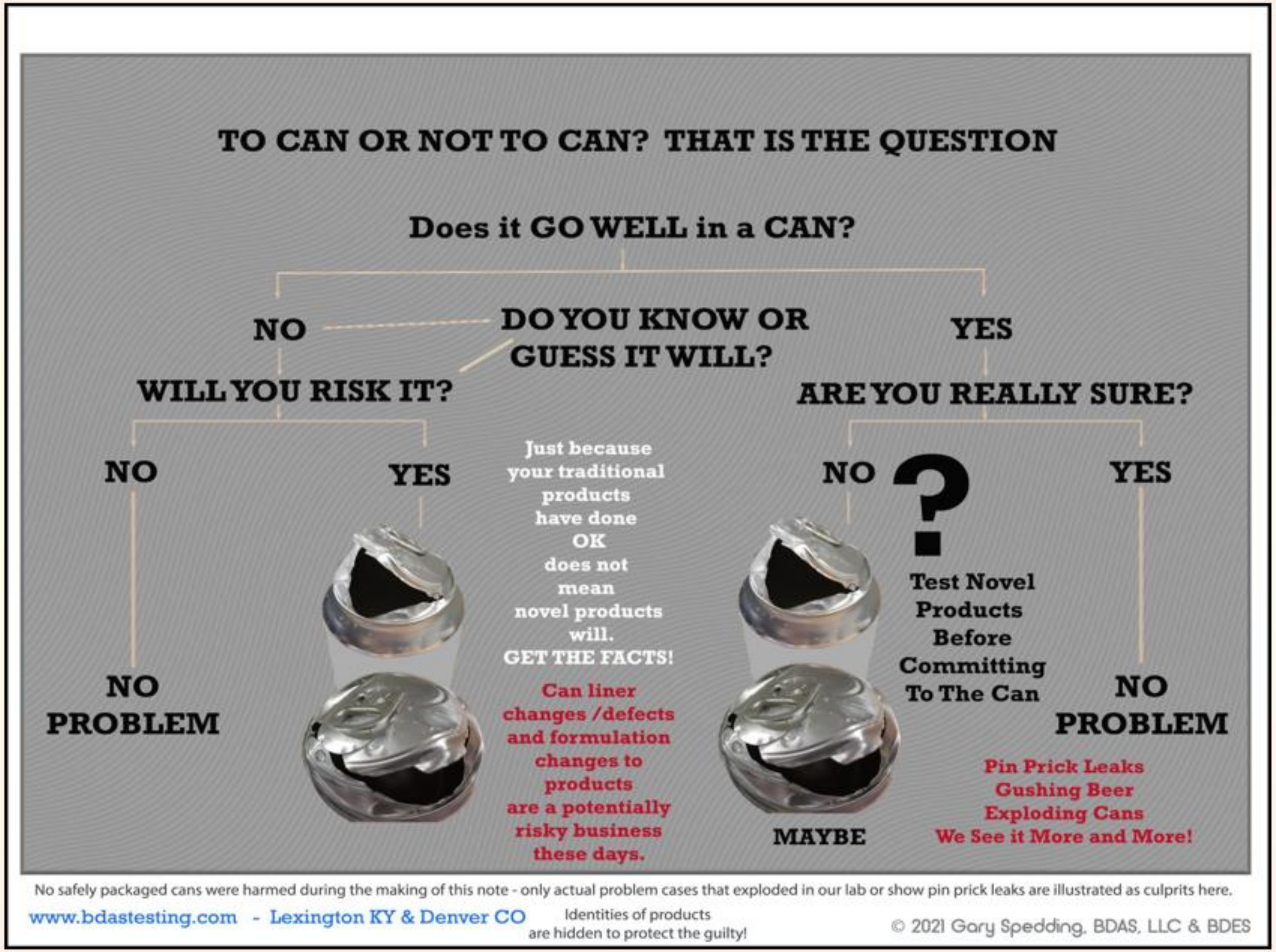
SO, BEFORE YOU HEAD TO THE CAN

QC Checks follow…

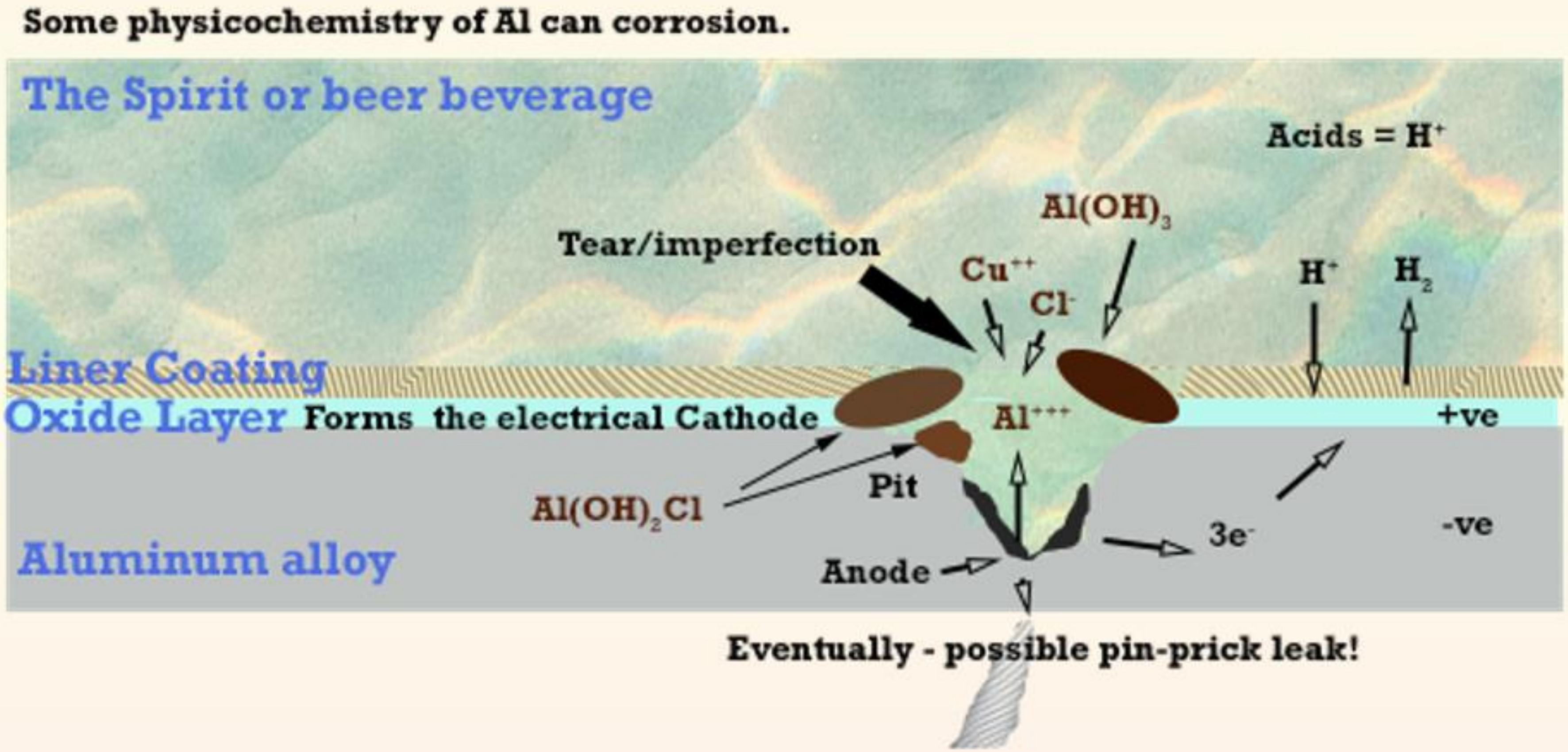
Pose Questions

Then Act Accordingly

Factors follow in this discussion

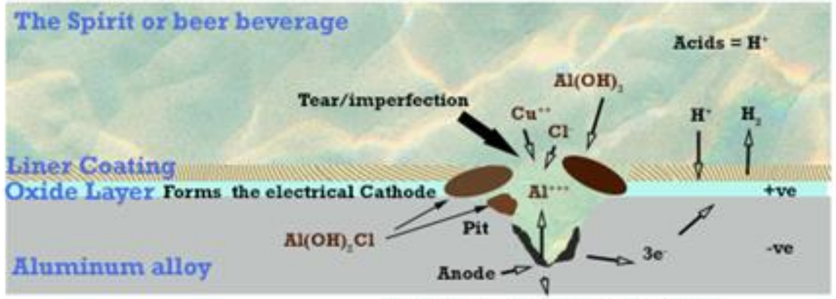


To Can or to CAN NOT!? What can go Wrong?



Galvanic Corrosion – A Battery in a Can & Assault & Battery in a Can!

Some physicochemistry of Al can corrosion.



Eventually - possible pin-prick leak!

Pin prick leaks can be hidden or "blocked" by an outer can sleeve but still leak in trade or in transit to a lab!

As of 2012 we still do not know a lot about newer can/liner/product interactions. We still have a long way to go. The Covid year(s) have not aided us much in this respect.

An oxide film - combination of aluminum with oxygen Al_2O_3 & $Al_2O_3.H_2O$ on material surfaces, is unstable in solutions with pH < 4.5. Accelerated corrosions occur with Cl^- & Cu^{++} ions, O_2, and sanitizer residues.

Certain preservatives are an issue too - Sodium benzoate is bad/Red #40 is pretty bad also.

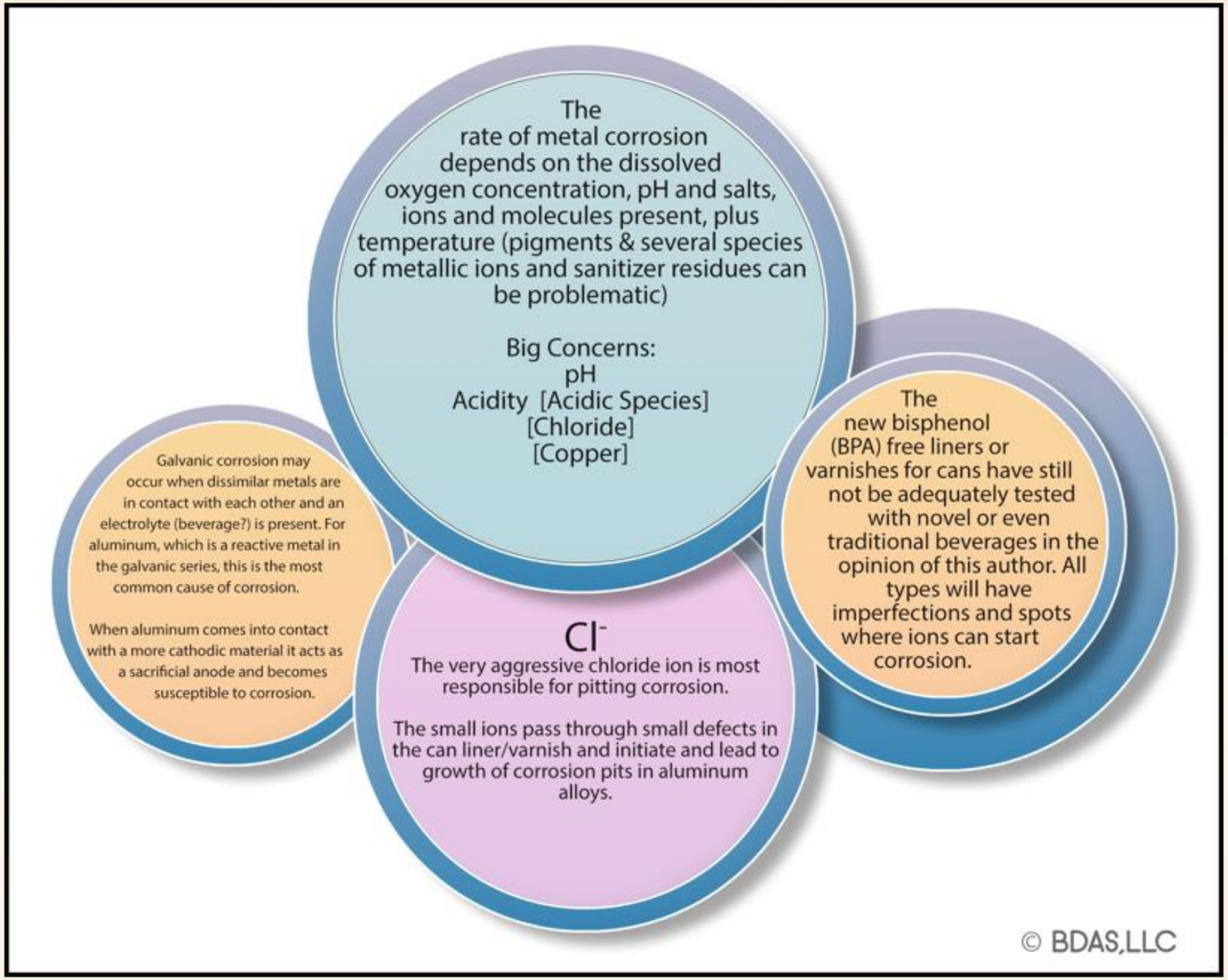
https://www.wired.com/2015/03/secret-life-aluminum-can-true-modern-marvel/

"Some beverages are so corrosive that no amount of coating will protect their cans. (Roughly one in seven new energy drinks are too corrosive to put in cans)".

Galvanic corrosion may occur when dissimilar metals are in contact with each other and an electrolyte (beverage?) is present. For aluminum, which is a reactive metal in the galvanic series, this is the most common cause of corrosion (Galvanic: relating to or involving electric currents produced by chemical action). When aluminum comes into contact with a more cathodic material it acts as a sacrificial anode and becomes susceptible to corrosion.

The electrolysis - think battery - at the copper/aluminum interface corrodes the surface and can lead to the pin-prick leaks seen in many modern beverage products

Galvanic Corrosion: The Factors



Summary I

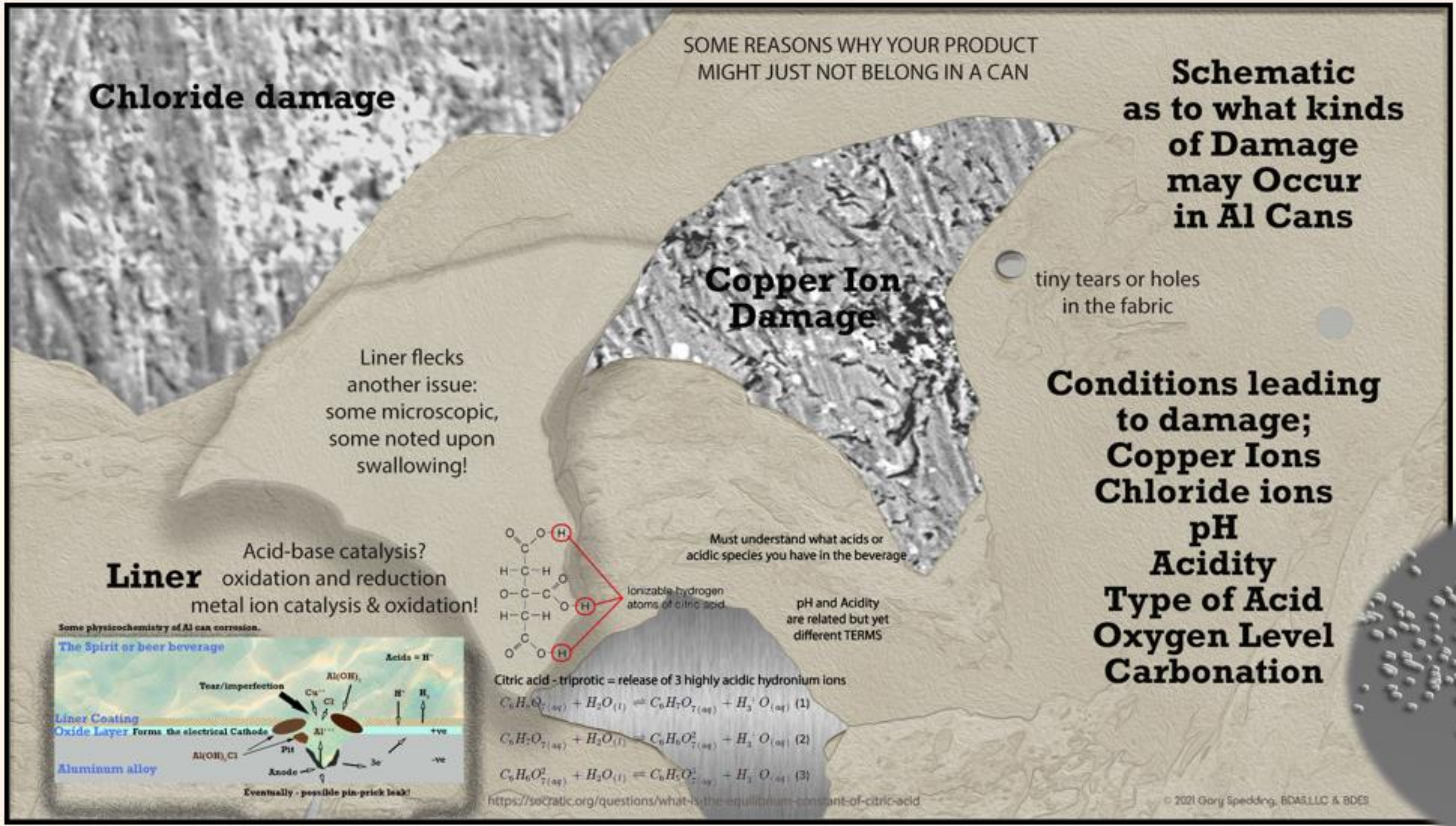
STEEL or ALUMINUM CAN PROBLEMS

It is the combination of factors that makes things worse - so diligence and complete formula understanding is important, and testing cans/liners with new beverages is a MUST!

CAN LINERS

At BDAS, LLC we have been approached by several clients complaining of can liner failure. In these cases chunks of liner material break loose and many are quite notable - visually unappealing, and certainly detectable as they slip down a throat - like a piece of thin plastic film or gel. Some are notable only microscopically or as tiny specks noted upon cutting open a can and looking for tiny flecks of matter.

Summary II



Could flecks of liner or fruit pulp pose an issue for gushing?

See Dr. Fox's Section for details on haze & gushing factors

KEY PAPERS TO LOOK AT FOR THIS TOPIC - I

Packaging Technology and Science

PACKAGING TECHNOLOGY AND SCIENCE
Packag. Technol. Sci. 2016; **29**: 65–73
Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/pts.2187

Characterization of Carbonated Beverages Associated to Corrosion of Aluminium Packaging

By Beatriz Maria Curtio Soares,[1,2*] Carlos Alberto Rodrigues Anjos,[2] Taiane Bonfante Faria[1] and Sílvia Tondella Dantas[1]

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The objectives of this study were to evaluate the characteristics of commercial soft drinks related with the corrosion process of the aluminium packaging and based on that, propose model solutions for future studies of beverage/package interaction and corrosion process of metal packages. Therefore, the pH, acidity, concentration of chlorides and copper in six types of soft drinks were determined, as well as the corrosion potential of the aluminium and the current density corrosion obtained in polarization curves using the beverages as electrolyte. Based on the results obtained, a solution of citric acid (pH = 3) containing chloride (250 mg/kg) and copper ions (250 µg/kg) is proposed. The obtained results are potentially useful for the industry and future studies regarding the interaction process between soft drinks and aluminium cans.

KEY PAPERS TO LOOK AT FOR THIS TOPIC - 2

JOURNAL OF THE AMERICAN SOCIETY OF BREWING CHEMISTS
2020, VOL. 78, NO. 4, 279–283
https://doi.org/10.1080/03610470.2020.1784634

ASBC Taylor & Francis

Check for updates

NOTE

Corrosion Resistance of Aluminum Beer Cans Containing Hand Sanitizer

Euan L. Thomson[a] and Andrew R. Bullied[b]

[a]Raft Beer Labs, Calgary, Alberta, Canada; [b]Annex Ale Project, Calgary, Alberta, Canada

ABSTRACT

The COVID-19 crisis and ensuing supply chain disruptions prompted many breweries and distilleries to repurpose their facilities for the production of hand sanitizer, with the vast majority following the World Health Organization formulation (80% v/v ethanol, 1.45% v/v glycerol and 0.125% v/v hydrogen peroxide). The long term shift from bottling to canning among craft brewers left canning as the sole scalable option for many facilities to package hand sanitizer. With essential services desperate for hand sanitizer to help protect their staff, patients, and clients, many breweries moved to package these products in cans despite warnings that they are not designed to hold solutions containing high ethanol concentrations or strong oxidizers. The present study explores the resistance of ubiquitous can liners, WB Modified Epoxy and BPANI Gen 2, to WHO formulated hand sanitizer. Shelf life observations and microscopic visualization show the WB Modified Epoxy liner withstands hand sanitizer with little observable disruption at room temperature, while BPANI Gen 2 liners permit package failure and liquid leakage within 30 days. Incubation at 37 °C accelerated the rate of failure sixfold in BPANI Gen 2 lined cans versus room temperature incubation, providing a basis by which to expect an approximately 72 day shelf life for WB Modified Epoxy lined cans. Because of the inherent risk to consumers presented by these data and despite lack of clear guidance from regulatory agencies, manufacturers should strive to cease packaging hand sanitizer in cans and instead find supplies of inert non-beverage containers.

KEYWORDS
Aluminum can; brewery; aluminum corrosion; COVID-19; hand sanitizer

NEW CAN LINERS WILL THEY STAND UP?

SEAMS SEALED?

EXPLODING CANS at THE BAR!!

STUDIES & METHODS TO LOOK AT THE ISSUES

As originally published in the SMTA Proceedings.

THE STUDY OF CORROSION BEHAVIOUR OF CU IN SOME COMMERCIAL BEVERAGES BY CHEMICAL AND ELECTROCHEMICAL MEASUREMENT

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ABSTRACT:
The corrosion behaviour of pure copper in 16 selected commercial beverages was studied. Experiments were also conducted in the presence of citric and phosphoric acids to investigate their role in the corrosion process in these beverages. Two experimental approaches were used to investigate the corrosion behavior: a chemical method in which the dissolved metal concentration was measured after immersion of a sample in a beverage and an electrochemical method using the Tafel extrapolation technique. The metal

in the electronics industry. A typical PCB consists of a copper connection path integrated in a fiberglass reinforced epoxy polymer.

In the electronics industry, one of the most common reasons for failure of devices is metal corrosion. Numerous research reports related to metal corrosion behaviour have been published [1]. Metal corrosion is usually a very complex phenomenon. Different types of corrosion can occur simultaneously in the same media and under the same environmental conditions. Corrosion is affected by many factors that are related to the environment and to the metal.

STUDIES & METHODS TO LOOK AT THE ISSUES

Scientific Bulletin. Series F. Biotechnologies, Vol. XVII, 2013
ISSN 2285-1364, CD-ROM ISSN 2285-5521, ISSN Online 2285-1372, ISSN-L 2285-1364

STUDY ON THE INTERACTION BETWEEN THE FOOD MATRIX AND THE METAL FOOD CANS

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Abstract

The metal cans are used to preserve food and beverages for long periods of time, proving to be one of the most versatile packaging materials nowadays. Some of their vital functionalities are represented by ensuring that foods are not contaminated, providing physical protection and extending the shelf life of it.
Metal cans are protected on the inside by a thin coating layer, which can be affected by stroke. Thus, the canned food or beverage comes in direct contact with packaging metal. The coating is an epoxy lacquer that separates the liquid from the packaging material. Normally, the metal cans are affected by corrosion (primary, secondary or stress corrosion). However there are several factors which can accelerate the corrosion processes.

Lacquered cans are a best practice solution – however they are still susceptible to residual chemical migration from the product or beverage.

90% of damaged cans, scratched or dented were found to have lost their lacquer integrity to some extent.

Shows us more studies needed!

Canny QC In-house? Or Third Party?

Examine inside cans for liner damage and major issues with the metal.

Electron microscopy might be needed – Third Party Lab.

Metal surface – examination. A specialist lab exists in Lexington

Look for hazes, sediments, mold, Fruit pulp and carbonation can be a bad thing. Liner intact – small holes/tears?

Copper, chlorides, certain acids problematic.

Force test beverages with new products. Get can manufacturer to test YOUR product for stability.

END

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BREWERS ASSOCIATION

THANKS!

Thermo Fisher SCIENTIFIC