Security and Anti-Counterfeiting Technologies for Packaging and Labels: An Easy Guide to Unravel the Myths

A discussion of the latest in covert inks, color-shifting ink pigments, taggart-markers, tamper evident security seals, digital UID codes and other available technologies used to detect and deter product compromise.

www.authentix.com
Introduction

The chances are that we have all encountered counterfeit products at one time or another, often without even knowing it. In fact, it’s commonly reported that over 80 percent of all global consumers have unknowingly bought a falsified product at some point.

There is an ever-growing problem of product counterfeiting in a multitude of markets. This poses a very serious problem in areas such as food, medicines, liquor, beverages, apparel and a host of other consumer products. The effects of this product compromise are far-reaching, including financial losses to brand owners and more importantly, the risks posed to consumer health and safety. These falsified products are often produced without regard to the correct ingredients, quality control, and government oversight in place to help ensure consumer safety and confidence.

Some brand owners started to build dedicated infrastructure and resources to combat product fraud decades ago, and many of those early adopters have enjoyed a vast improvement in the detection and reduction of these goods in their supply chain. Industries where goods are critical to human health, have been most active while other industries have been slower to move in this area and still are plagued with the problem as distribution continues to go global and visibility of the supply chain becomes blurred. Instituting solution countermeasures to detect and prevent product fraud might be easier than most think, but it’s important to first address just how big of a problem this is and what the implications are to companies today.
To estimate the total scope of the problem, you can turn to multiple sources including the World Health Organization, the International Chamber of Commerce, the IACC, and a host of other organizations who report on the global trade in counterfeit goods. Depending on the source, these figures range between a total impact of $1 trillion to over $1.7 trillion US Dollars of counterfeit goods entering the global market annually.

Some of the more impacted markets, such as the pharmaceutical industry alone are estimated at over $200 billion per year. In fact, some estimates are that over 30 percent of all drugs sold in developing countries are fakes putting millions of lives at risk daily. However, whether you sell medical devices, microchips, tennis shoes, fashion watches, or baby formula, it is certain that you are a target for nefarious parties aiming to profit from faking the valuable brand goods and designs you have legitimately built over years or decades. For instance, not only can counterfeit drugs lead to dangerous health side effects and even death but publicly known product compromise can also quickly erode consumer confidence and the value of the brand and business overnight.

Figure 1 below shows more statistics and brings to the forefront the serious and material impact counterfeit goods are having.

**Fig. 1 - Global Facts and Figures**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.0-$1.7 Trillion USD</td>
<td>Total latest estimated value of global trade in fake goods¹</td>
</tr>
<tr>
<td>15%</td>
<td>Amount of FY 2017 seizures in apparel accessories, the largest category seized within all merchandise²</td>
</tr>
<tr>
<td>$323 Billion USD</td>
<td>Amount of estimated losses due to global online counterfeiting in 2017³</td>
</tr>
<tr>
<td>$30.3 Billion USD</td>
<td>Total losses by luxury brands due to online counterfeiting⁴</td>
</tr>
<tr>
<td>$2.3 Trillion USD</td>
<td>INTA and ICC report indicates counterfeiting could reach by 2022⁵</td>
</tr>
<tr>
<td>~70% - 80%</td>
<td>Est. of percent of counterfeiting products seized originate in China⁶</td>
</tr>
<tr>
<td>$153.9 Billion USD</td>
<td>Value of the secure packaging market by 2020⁷</td>
</tr>
<tr>
<td>34,143</td>
<td>US Customs and Border Protection seized worth $1.2 billion USD⁸</td>
</tr>
<tr>
<td>Over 5.0 Million</td>
<td>Est of global jobs lost due to counterfeit goods by 2022⁹</td>
</tr>
</tbody>
</table>

References:

⁶ Est. of percent of counterfeiting products that originate and are exported from China: [https://www.businessinsider.com/most-counterfeit-goods-are-from-china-2013-6](https://www.businessinsider.com/most-counterfeit-goods-are-from-china-2013-6)
⁸ US Customs and Border Protection seized worth $1.0+ billion USD: [https://books.google.com/books?id=hzR0awMNQOC&pg=PA43&dq=US+Customs+and+Border+Protection+seized+worth+$1.2+billion+USD+source=hlq&ei=qR9KhsV77fuoQwPIKxVw&sa=X&ved=2ahUKEwiU5K3jksHjAhVwpVkKHV1-BukAQ6BAgBEAI#v=onepage&q=US%20Customs%20and%20Border%20Protection%20seized%20worth%3E%3D%20$1.2%20billion%20USD%26f=false](https://books.google.com/books?id=hzR0awMNQOC&pg=PA43&dq=US+Customs+and+Border+Protection+seized+worth+$1.2+billion+USD+source=hlq&ei=qR9KhsV77fuoQwPIKxVw&sa=X&ved=2ahUKEwiU5K3jksHjAhVwpVkKHV1-BukAQ6BAgBEAI#v=onepage&q=US%20Customs%20and%20Border%20Protection%20seized%20worth%3E%3D%20$1.2%20billion%20USD%26f=false)
¹⁰ 30% of all drugs sold in developing countries are fakes (per text in 3rd paragraph): [https://www.who.int/medicines/regulation/srrfs/publications/GSMS_Report_layout.pdf?ua=1](https://www.who.int/medicines/regulation/srrfs/publications/GSMS_Report_layout.pdf?ua=1)
For the affected brand owners who are late to deploy comprehensive product protection in their supply chains, it is likely that in the near future the costs of addressing a counterfeiting incident will rise and create chaos, financial harm, and devastating consequences for many stakeholders in the organization. Often brand owners are caught unaware and don’t have the reactive processes and protocols in place to deal with these issues that weaken and disrupt the business. Moreover, the different departments and stakeholders within an organization will typically not be well-coordinated to combat the counterfeiters due to the lack of detectability to find and measure the extent of the problem. In the end, the event becomes a recovery process that could take months or even years to fully address.

There is good news; however, in that, your company, or your client (if you are a printer or packaging converter) can start the process of planning and implementing product security right away. In 2019, there are a host of experienced brand protection solution providers with global reach and resources. Many of these companies offer a myriad of solutions that are quickly deployable. This will put you or your customer in a position of offense rather than defense, and future incidents can be dealt with faster, your customers will be safer, and the financial impact of an adverse product event will be far more controllable and mitigated.

**Today’s Product Security Technologies – What You Should Know**

Traditionally, anti-counterfeiting security solutions can be categorized into five different platforms:

- **Overt security** - Holograms, specialty inks, color-shifting inks – (things you can see and notice without equipment or scanners)
- **Covert security** - Ultraviolet inks [UV], infrared [IR] inks, invisible taggants embedded in substrates, and inks with other specialized markers
- **Semi-covert** - Pantographs, micro text, metameric inks, scrambled indicia, special effect inks, coin reactive inks, and thermochromic inks (things you might not notice until pointed out)
- **Forensic** - Molecular taggants, DNA, nanoparticle coatings
- **Digital** - This normally includes a host of solutions (can include the above) relating to numeric values or digital symbology that can, in turn, enable users to look up related product authentication data either via the internet or through a proprietary localized database

**The Bottom Line – Which Anticounterfeiting Technology is the Best?**

As decades of experience in the areas of security documents, currency, and product anti-counterfeiting efforts have shown, there is not a single “silver bullet” technology that can be applied across the board for all products. A multi-layered approach (as used in currency) usually is the most effective long term. Of the above mentioned five categories of solutions, the prevalent technology implemented and most often recommended is “on-package” or “on label” solutions consisting of specialized inks or substrate markers. These can either be discernable with the human eye or interpreted through a provider supplied proprietary device.

Conversely, direct product chemical or physical testing is the least routinely utilized method but is often the last step to forensically determine authenticity if no other method is deployed. However, it is important to keep all five (5) categories in view and to understand the costs, appropriate applications, and their selection depends on a given situation and a firm’s overall risk and objectives. In some cases, a simple color-shifting ink and hidden IR
code might be best for one product line, while a tamper-evident seal with an invisible IR ink might be better for another. In many cases, the decision might rest on the packaging type and access to distribution or retail settings for inspection.

Ironically, advancing digital, printing, and manufacturing technology now available to everyone has driven the ease of entry for counterfeiters into any given market while vastly improving the quality of the counterfeit packaging as well as the appearance and attributes of fake products. However, and somewhat ironically, it is this same advancing technology, which can also provide countermeasures and solutions to combat these problems.

Below we summarize some of the leading anti-counterfeiting technology solutions deployed throughout the world today.

**Digital Solutions**

Unit level tracking using a database of unique item level numbers or even a complete serialization system is very much in the news these days. Typically, these technologies encompass applying a unique code, number, symbol, etc. and recording those codes or numbers in a database. During production, it is also possible to record variable product information regarding unique attributes such as manufacturing date/time, expiration dates, lot numbers, pictures, and a host of other origin information. Later, as the product travels through the supply chain, the unique number or symbol can be collected, and the information in the database can be revealed to the user via the internet or on a localized database residing on the collection device.

In a track & trace system, the information flow can be bi-directional, meaning that the collection of the symbology and the unique call to the database can also be recording and appended to the product record. Thus, information about those scans or collections builds during the product’s supply chain travel to show authentication collection including the location, time, date, and even user information about the inspections occurring in the field.

There is a myriad of complexities to these digital systems – some can be very simple allowing the user to confirm a yes/no result on authentication while other systems can show the complete variable information including detailed accounting of product movement in the supply chain all the way to retail purchase and ultimate deactivation of the product’s unique ID number. The more complex the system, the more investment into expensive infrastructure is needed, including readers, scanners, databases, web applications, mobile device updates, and even personnel to implement and maintain the system. It should be noted that automated capability to identify and fetch or input product level digital information alone is not recognized by current ISO standards as a stand-alone anti-counterfeiting solution. Unless the number or symbol can’t be copied and reproduced, it is possible to simply copy the package bar code or number, thereby enabling the counterfeit product to be authenticated as genuine. This is especially true if the ‘read rates’ of product information is only a fraction of the products actually produced. Unless 100 percent of the products are continually scanned and accounted for, it is possible for copied labels or packaging to enter the system and be validated. To prevent this,
it is also necessary to have covert or uncopiable numbers or symbols that specially programed collection devices or applications can identify as unique.

Another digital tool available is Radio Frequency Identification (RFID), which is usually a small antenna and receiver system where a unique product level ID is hidden or embedded in a small chip or printed label. In some cases, the chip residing on the product can have its own power source (active) or can be energized through the collection device itself (passive). Thus, the ability of these “electronic labels” to communicate with a centralized database system has all the features of and performs very similarly to bar codes and other track and trace systems as described earlier. However, RFID can be expensive on a per-product basis and has limitations on many applications, including potential interference of the signal via ambient conditions. Lastly, it should be noted that Track and Trace systems are not able to counter materials that move covertly or surreptitiously around legitimate supply chains such as when counterfeit samples are distributed through e-commerce.

**Direct Physical Product Testing**

Also known as forensic analysis, direct product testing is typically carried out in a laboratory setting to determine product authenticity by analyzing certain unique elements of physical product construction or ingredients. Traditionally, this has been a key approach in generating needed evidence for legal proceedings.

Simply confirming or rejecting that a product is comprised of the expected materials doesn’t necessarily trace the product back to its source and confirm provenance if the counterfeiter is successful at constructing the product in a similar manner. Nonetheless, many manufacturers have used this method for decades to verify genuine from fakes. However, using this ‘reverse’ analysis isn’t always foolproof to determine authenticity unless a unique or hidden tracing element can be added to the product and such tracing element is confirmed through QC measures under legitimate manufacturing.

When using a unique and non-reproduceable marker or identifier on board the product is far more powerful when chemical and physical analysis methods and high-power analytical lab instruments are used to find taggants or other items used as markers to identify a product. Such analysis is slow and costly and may require the destruction of the product in the process (Table 1).

**On-Package or On Label Product Security**

The most widely used product security technology is the use of security inks or other marking systems on package or label. This can be either through covert (hidden) markings or overt (human discernable) features. Benefits of this approach include ease of implementation, ability to be integrated into existing processes and can provide rapid “Yes/No” determinations (Table 1).

Overt and covert security features can be supplied as inks, coatings, and taggants, and can also be applied in plastic packaging as concentrates for blending into plastic feedstock and masterbatch processes. Covert (hidden) solutions offer a high level of security and are often viewed as a second line of defense. Overt features, on the
other hand, are clearly visible to the naked eye and do not require a special reader, and therefore generally seen as significantly less secure. These can include the use of holograms, inks that change color based on the viewing angle, inks that appear or disappear based upon temperature changes, and many more.

TABLE 1 – Print and packaging security features can be further broken down into three security levels in labels and packaging (e.g., plastic, cardboard, cans, bottles) to determine if an item is authentic

<table>
<thead>
<tr>
<th>Level</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Primary (Overt)</td>
<td>A visual and sometimes tactile anti-counterfeiting security feature, which can be checked by the consumer, investigator, or retail personnel. This type of testing can generally be done quickly (&lt; 30 sec.)</td>
</tr>
<tr>
<td>2</td>
<td>Secondary (Covert)</td>
<td>A hidden anti-counterfeiting feature, which can be checked/examined using a reader device (reader, UV lamps, laser penlights...)</td>
</tr>
<tr>
<td>3</td>
<td>Tertiary (Forensic)</td>
<td>A high-end complex anti-counterfeiting feature that requires laboratory analysis to determine its presence. Such testing must be done by laboratory testing and can require considerable time and expense but is of great value in litigation situations</td>
</tr>
</tbody>
</table>

In terms of application, whether overt, covert or “semi-covert” solution types -- each represents a different level of security (low medium, high) due to the level of difficulty to identify and duplicate and the complexity of specific detection devices used in authentication. An overt application can be identified by sight or possibly by another human sense such as taste. A covert application usually implies the use of micro or nano-taggants or invisible material, which are invisible or hidden from detection via human senses but can be uncovered by a user using a specialized reader or collection method. Semi-covert is a visible or semi-visible marking, which can be seen by the naked eye upon manipulation or specialized instruction but otherwise may go unnoticed until the feature is pointed out. An example would include a color-changing ink as found on many banknotes today.

TABLE 2: Benefits of an on-packaging approach when used in labels and packaging

<table>
<thead>
<tr>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Low Cost</td>
</tr>
<tr>
<td>2 Ability to be integrated into existing processes (print and molding)</td>
</tr>
<tr>
<td>3 Rapid yes/no determinations for in-field users or customs officials</td>
</tr>
<tr>
<td>4 Easily implemented</td>
</tr>
<tr>
<td>5 Number of features is easily scalable or layered</td>
</tr>
</tbody>
</table>

The Role of Brand Protection in Security Packaging and Labeling

As discussed, the most utilized type of security application is the on-package or on-label approach. Level 3 covert solutions often contain some form of taggant in a security ink that is only detectable or visible through a sophisticated hand-held reader or test (see Figure 3, A Note on Taggants). Products utilizing taggants as security features are often supplied with this feature in the form of standard press-ready inks (including over-print varnishes and coatings) suitable for direct application or as concentrates suitable for blending into plastic for injection molding, extrusion followed by thermoforming or blown molding. Additionally, packaging or labels can
be printed with these security inks or coatings without having to materially adjust or modify any existing printing equipment or preexisting processes.

**Figure 3 - A Note on Taggants - with an Example of an Anti-counterfeiting Field Reader (Authentix HVX 1500 type)**

A word about taggants and packaging (paper/plastic) - Taggants can be added into various materials, including inks, coating, films, and plastics. Taggants are uniquely encoded materials or chemistries that are deemed virtually impossible to duplicate. A taggant can be likened to a fingerprint – that is a unique signature of identity to which a brand owner or investigator assign meaning. Taggants are covert and are used for a wide variety of applications. Typically, in anti-counterfeiting or security documents applications. Taggants are of two types: optically readable (i.e., can be read by a field reader (e.g., fluorescent materials) or forensic and read/detected in a laboratory setting (e.g., DNA...)

As mentioned, to simplify identification, sophisticated readers are often specifically tuned to look for unique optical or other physical elements of a taggant. Proprietary detection devices can be tuned to detect multiple special characteristics before internal algorithms decipher a “Yes/No” determination.

The most sophisticated optical taggants are usually from infrared (IR) based fluorescent materials/molecules and are detectable by handheld field readers. Fluorescence is the emission of light by matter after it is hit or irradiated with light of a different wavelength. In most cases, the emitted light (such as a laser) is of a longer wavelength than the source light (this is called “down-converting” fluorescence). Fluorescent inks used for security purposes “glow” in the IR ranges and are not visible to the naked eye. This effect is totally reversible and ends once the excitation light source is turned off.

IR Florescent taggants are the most widely used of the taggant types due to their high level of security. Standard Type A UV taggants (seen with black light sources) are now generally regarded as lower-level security and single-color applied UV marks can be readily be located and such inks are easily sourced on the open market. However, utilizing highly complex UV marks in multiple colors can be an alternative approach to making UV technology much more secure.
TABLE 3 – A breakdown of some of the more common packaging and printed material anti-counterfeiting technologies, which can be incorporated at different levels into labels and packaging to determine product authenticity.

| 1 | Primary (Overt) | - Color Changing inks  
|   |                 | - Holograms  
|   |                 | - Simple codes  
|   |                 | - Watermarks (in paper)  
| 2 | Secondary (Covert) | - Advanced IR taggants – in inks, coating, plastic...  
|   |                 | - UV inks  
|   |                 | - Complex codes  
|   |                 | - Laser activating inks  
|   |                 | - Hidden image technology  
| 3 | Tertiary (Forensic) | - Forensic markers  
|   |                 | - DNA type inks for forensic examination  
|   |                 | - Spectrographic signature analysis  

Conclusions and Final Comments

Most often, brand protection technologies can be applied directly to paper labels and packaging and increasingly into plastic parts (e.g., bottle caps, etc.). Costs are typically low on a per-item basis ranging from a few pennies and even in some cases, a fraction of a penny depending on unit volume. High-end security solutions are often sold based on a unit level basis or, as referred to in the printing industry, on a “per-click” basis. Normally, security solutions are not sold by weight or volumetric measurements, which can be a misconception held by traditional printers and converters. The higher-level security solutions are proprietary and not available to the general public and are manufactured in highly secure facilities with proper certifications and accreditations.

Increasingly, more companies are utilizing in-house anti-counterfeiting experts to handle brand protection, IP, and anti-counterfeiting issues. These designated personnel and departments evaluate the issues and level of risk exposure of a firm’s brands and product portfolio and then select the appropriate anti-counterfeiting technology to deploy. Security personnel might ask:

- Has this product become or will it likely become a target for counterfeiters?
- Has this kind of product been counterfeited before?
- Is the territory or geography a known area of counterfeit practices?

Products identified as being at high risk are usually those that have some type of vulnerability. Based on this assessment, the appropriate anti-counterfeiting technology is selected, implemented, and deployed.

As the rate and extent of the problem of global counterfeiting grows, it is increasingly important for firms to take steps to protect their products by taking measures to prevent and deter counterfeiting. A first step is understanding the options and technologies available.
ABOUT THE AUTHOR
Richard Gill is a Business Development and Marketing Consultant at Authentix and former R&D Forensic Group Leader and is considered a subject matter expert in brand protection. Based on the large number of brand protection professionals he speaks to each year, he is well placed to discuss authentication technology and current marketplace trends being utilized by brand owners to combat the growing challenge of global counterfeiting.

ABOUT AUTHENTIX
As the authority in authentication solutions, Authentix helps customers thrive in supply and distribution chain complexity. We provide advanced authentication solutions for governments, central banks and commercial products, ensuring local economies grow, banknote security remains intact and commercial products have robust market opportunities. Our partnership approach and proven sector expertise inspires proactive innovation, helping customers mitigate risks to promote revenue growth and gain competitive advantage.

Is your company in need of a fresh perspective in how to protect your complex supply and distribution chain?

If so, we can help.
Contact us at info@authentix.com

UNITED STATES (Corporate)
4355 Excel Parkway
Suite 100
Addison, TX 75001

Additional Locations:
Europe | Middle East | Africa