EPO - DG 2
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1. An apparatus for inspecting a case having a plurality of packages (1040) and determining whether a substance in each of the packages is spoiled, said apparatus comprising:

an inspection system (710) comprising:

an electromagnetic source for generating an electromagnetic signal;

a plurality of electromagnetic scan systems (1050), each electromagnetic scan system corresponding to a package of the plurality of packages, said electromagnetic scan system for receiving the generated electromagnetic signal, directing the received signal at a corresponding package, and receiving an attenuated electromagnetic signal from the corresponding package;

a processor for determining whether each package contains spoiled substance as a function of the attenuated electromagnetic signal received from the package; and

a sampler for sampling the received attenuated signal and generating a set of data points representative of an amplitude of the received attenuated signal over a predetermined period of time; and

the processor analyzes each set of data points, wherein the processor:

detects a peak within the set of data points,

shifts the data points with respect to time based on the detected peak, and

compares the set of shifted data points to at least one mathematical model to determine whether the package contains spoiled substance.

2. The apparatus of claim 1 further comprising a labeling system for marking a case having at least one package (1040) containing spoiled substance

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3. The apparatus of claim 1 wherein the processor analyzes each set of data points without generating an image from the data points, and wherein the processor shifts the set of data points with respect to time in order to align the detected peak (102, 104, 106, 108) with a predetermined time.

4. The apparatus of claim 2 further comprising a culling system (712) for removing cases marked by the labeling system from a production line (706), said production line comprising the inspection system (710), wherein marking a case comprises identifying the case in a database and wherein the culling system accesses the database to identify cases to be removed from the production line.

5. The apparatus of claim 2 further comprising a culling system (712) for removing cases marked by the labeling system from a production line (706), said production line comprising the inspection system (710), wherein the labeling system marks a case by placing a marking on the case in ultraviolet light reactive print, and wherein the culling system comprises an ultraviolet light source and scanner for detecting the mark on the case.

6. The apparatus of claim 1 further comprising a first robot (702) for removing cases from a pallet (704) for inspection by the inspection system (710), and a second robot (716) for placing inspected cases on a pallet (718).

7. The apparatus of claim 2 wherein the labeling system marks the case to identify which of the packages (1040) in the case contain spoiled substance.

8. The apparatus of claim 1 wherein the electromagnetic signal is in the range of about 0.02 terahertz to about 3.5 terahertz.

9. The apparatus of claim 3 wherein:
the substance is aseptically packaged into the package (1040);
the substance is a biological fluid; and

the at least one mathematical model corresponds to a package containing non-spoiled substance.

10. The apparatus of claim 1 wherein the package (1040) comprises at least one of linear low density polyethylene (LLDPE), barrier coated polyethylene terephthalate (PET), aluminum oxide coated PET, ethylene vinyl alcohol (EVOH), Silicone Oxide (SiOx), and High Density Polyethylene (HDPE).

11. The apparatus of claim 1 wherein the processor determines whether the substance in the package (1040) is spoiled by determining that the substance in the package comprises at least one of B. Subtilis, S. Epidermidis, L. Casei, E. Cloacae, Saccharomyces Cerevisiae, or C. Sporogenes.

12. A method for inspecting (506) a case having a plurality of packages (1040) and determining whether a substance in each of the packages is spoiled, said method comprising:

generating an electromagnetic signal;

scanning the case, said scanning comprising:

receiving the generated electromagnetic signal at one of a plurality of electromagnetic scan systems, each electromagnetic scan system corresponding to one of the plurality of packages in the case,

directing the received signal at the corresponding package, and

receiving an attenuated electromagnetic signal from the corresponding package at the corresponding electromagnetic scan system;

sampling the received attenuated signal and generating a set of data points representative of an amplitude of the received attenuated signal over a predetermined period of time

analyzing (508) each set of data points by detecting a peak within the set of data points, shifting the data points with respect to time based on the detected

peak, and comparing the set of shifted data points to at least one mathematical model; and

determining whether the package contains spoiled substance as a function of said analyzing.

13. An apparatus for inspecting a case having a plurality of packages (1040) and determining whether a substance in each of the packages is spoiled, said apparatus comprising:

an inspection system (710) comprising:

an electromagnetic source for generating an electromagnetic signal;

a plurality of electromagnetic scan systems (1050), each electro magnetic scan system corresponding to a package of the plurality of packages, said electromagnetic scan system for receiving the generated electromagnetic signal, directing the received signal at a corresponding package, and receiving an attenuated electromagnetic signal from the corresponding package;

a sampler for sampling the received attenuated signal and generating a set of data points representative of an amplitude of the received attenuated signal over a predetermined period of time; and

a processor for analyzing each set of data points, wherein the processor:

detects a peak (102, 104, 106, 108) within the set of data points,

shifts the data points with respect to time based on the detected peak, and

compares the set of shifted data points to at least one mathematical model to determine whether the package contains spoiled substance; and

a labeling system for marking a case having at least one package containing spoiled substance.

14. A method for inspecting a case having a plurality of packages (1040) and determining whether a substance in each of the packages is spoiled, said method comprising:

generating an electromagnetic signal;

scanning (506) the case, said scanning comprising:

receiving the generated electromagnetic signal on of a plurality of electromagnetic scan systems, each electromagnetic scan system corresponding to one of the plurality of packages in the case,

directing the received signal at the corresponding package, and

receiving an attenuated electromagnetic signal from the corresponding package at the corresponding electromagnetic scan system;

sampling each received attenuated signal;

generating a plurality of sets of data points, each set of data points representative of an amplitude of a corresponding received attenuated signal over a predetermined period of time;

analyzing (508) each set of data points, said analyzing comprising:

detecting a peak within the generated set of data points,

shifting the data points with respect to time based on the detected peak,

comparing the set of shifted data points to at least one mathematical model, and

determining whether the package contains spoiled substance as a function of said comparing; and

marking a case having at least one package containing spoiled substance.

15. An apparatus for inspecting a case having a plurality of packages (1040) and determining whether a substance in each of the packages is spoiled, said apparatus comprising:

an inspection system (710) comprising:

an electromagnetic source for generating an electromagnetic signal;

an plurality of electromagnetic scan systems (1050), each electromagnetic scan system corresponding to a package of the plurality of packages, said electromagnetic scan system for receiving the generated electromagnetic signal, directing the received signal at a corresponding package, and receiving an attenuated electromagnetic signal from the corresponding package;

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a sampler for sampling the received attenuated signal and generating a set of data points representative of an amplitude of the received attenuated signal over a predetermined period of time; and

a processor for analyzing each set of data points, wherein the processor:

detects a peak (102, 104, 106, 108) within the set of data points,

shifts the data points with respect to time based on the detected peak of the generated data points, and

determines whether the set of shifted data points correspond to a package containing a spoiled substance without generating an image from the set of data points; and

a labeling system for marking a case having at least one package containing spoiled substance.

CLAIMS

1. An apparatus for inspecting a case having a plurality of packages and determining whether a substance in each of the packages is spoiled, said apparatus comprising:

an inspection system comprising:

an electromagnetic source for generating an electromagnetic signal;

a plurality of electromagnetic scan systems, each electromagnetic scan system corresponding to a package of the plurality of packages, said electromagnetic scan system for receiving the generated electromagnetic signal, directing the received signal at a corresponding package, and receiving an attenuated electromagnetic signal from the corresponding package;

a processor for determining whether each package contains spoiled substance as a function of the attenuated electromagnetic signal received from the package; and

a sampler for sampling the received attenuated signal and generating a set of data points representative of an amplitude of the received attenuated signal over a predetermined period of time; and

a labeling system for marking a case having at least one package containing spoiled substance;

wherein the processor analyzes each set of data points, and wherein the processor:

detects a peak within the set of data points,

shifts the data points with respect to time based on the detected peak in order to align the detected peak with a predetermined time, and

compares the set of shifted data points to at least one mathematical model to determine whether the package contains spoiled substance.

2. The apparatus of claim 1 further comprising a culling system for removing cases marked by the labeling system from a production line, said production line comprising the inspection system, wherein marking a case comprises identifying the case in a database and wherein the culling system accesses the database to identify cases to be removed from the production line.

3. The apparatus of claim 1 further comprising a culling system for removing cases marked by the labeling system from a production line, said production line comprising the inspection system, wherein the labeling system marks a case by placing a marking on the case in ultraviolet light reactive print, and wherein the culling system comprises an ultraviolet light source and scanner for detecting the mark on the case.

4. The apparatus of claim 1 further comprising a first robot for removing cases from a pallet for inspection by the inspection system, and a second robot for placing inspected cases on a pallet.

5. The apparatus of claim 1 wherein the labeling system marks the case to identify which of the packages in the case contain spoiled substance.

6. The apparatus of claim 1 wherein the electromagnetic signal is in the range of 0.02 terahertz to 3.5 terahertz.

7. The apparatus of claim 1 wherein:

the substance is aseptically packaged into the package;

the substance is a biological fluid; and

the at least one mathematical model corresponds to a package containing non-spolied substance.

8. The apparatus of claim 1 wherein the package comprises at least one of linear low density polyethylene, barrier coated polyethylene terephthalate, aluminium oxide coated polyethylene terephthalate, ethylene vinyl alcohol, silicone oxide, and high density polyethylene.

9. The apparatus of claim 1 wherein the processor determines whether the substance in the package is spoiled by determining that the substance in the package comprises at least one

of B. Subtilis, S. Epidermidis, L. Casei, E. Cloacae, Saccharomyces Cerevisiae, or C. Sporogenes.

10. A method for inspecting a case having a plurality of packages and determining whether a substance in each of the packages is spoiled, said method comprising:

selecting a case having a plurality of packages, wherein a substance is aseptically packaged into the package, the substance is a biological fluid, and the package is substantially transparent with respect to a frequency of an electromagnetic signal;

generating an electromagnetic signal;

scanning the case, said scanning comprising:

receiving the generated electromagnetic signal on of a plurality of electromagnetic scan systems, each electromagnetic scan system corresponding to one of the plurality of packages in the case,

directing the received signal at the corresponding package, and

receiving an attenuated electromagnetic signal from the corresponding package at the corresponding electromagnetic scan system;

sampling each received attenuated signal;

generating a plurality of sets of data points, each set of data points representative of an amplitude of a corresponding received attenuated signal over a predetermined period of time;

analyzing each set of data points, said analyzing comprising:

detecting a peak within the generated set of data points,

shifting the data points with respect to time based on the detected peak,

comparing the set of shifted data points to at least one mathematical model, and

determining whether the package contains spoiled substance as a function of said comparing; and

marking a case having at least one package containing spoiled substance.