CLAIMS:

1. A sterilization apparatus configured for reducing microbial content of an article, the apparatus comprising: (i) a chlorine dioxide generation system for generating chlorine dioxide gas, (ii) a treatment chamber configured to receive the article, said treatment chamber being pressurized between 2 and 120 kPa, with an atmosphere that can have a relative humidity from about 20% to about 100% at a temperature from about 2 degrees Celsius to about 80 degrees Celsius, (iii) a ClO_2 scrubber, and (iv) and one or more sensing unit(s) in combination with a controller having software configured to sense and optionally adjust one or more conditions in the chlorine dioxide generation system, treatment chamber, and/or ClO_2 scrubber.

2. The apparatus of claim 1 including a buffer tank receiving the chlorine gas and building a pressure of at least 100 kPa.

3. The apparatus of claim 1 including an evacuation tank for receiving the chlorine dioxide gas after exposure to the article, said evacuation tank including a degradation enhancement device.

4. The apparatus of claim 1 wherein the chlorine dioxide is pulsed from the chlorine dioxide generation system into the treatment chamber.

5. The apparatus of claim 3 including a recirculation of chlorine dioxide from the evacuation tank to the treatment chamber.

6. The apparatus of claim 1 wherein the treatment chamber includes a means for aeration after sterilization of the article.

7. The apparatus of claim 3 wherein the degradation enhancement device comprises a UV lamp and//or a microwave generator.

8. The apparatus of claim 1 further including a steam generator for increasing relative humidity in the treatment chamber.

9. The apparatus of claim 8 wherein at least two of the ClO2 generation system, treatment chamber, steam generator, and ClO2 scrubber include a temperature detector.

10. The apparatus of claim 8 wherein at least two of the ClO2 generation system, treatment chamber, steam generator, and ClO_2 scrubber include a relative humidity detector.

11. The apparatus of claim 8 wherein at least two of the ClO2 generation system, treatment chamber, steam generator, and ClO2 scrubber include a pressure detector.

12. The apparatus of claim 8 wherein at least two of the ClO2 generation system, treatment chamber, evacuation tank, and ClO2 scrubber and include a gas concentration detector.

13. The apparatus of claim 8 wherein at least two of the ClO2 generation system, treatment chamber, steam generator, and ClO2 scrubber include a time detector.

14. The apparatus of claim 8 wherein the steam generator increases the temperature of the ClO_2 to at least 2° Celsius in the treatment chamber. The apparatus of claim 1 wherein the article comprises a pallet or a shipping container or a rack including multiple items to be sterilized.

15. The apparatus of claim 1 wherein at least one of the treatment chamber and/or ClO_2 scrubber further includes a magnetic field generator, a vacuum mechanism for emptying the treatment chamber after sterilization of the article, and a recirculation of chlorine dioxide within the treatment chamber with a blower; wherein the treatment chamber is capable of receiving a pallet of articles comprising a volume of at least 200 liters; wherein the chlorine dioxide generation system is electrochemical and has a capacity from 0.45 kg/day to at least 136kg/day ClO_2; wherein the treatment chamber is operated at ambient pressure; and wherein the chlorine dioxide generation system comprises a reaction $2NaClO2 + 2H_2O \rightarrow 2ClO_2 + H_2 + 2NaOH$.