CLAIMS:

We claim:

1. A process comprising steps of,

immersing an apparatus comprising a membrane aerated biofilm media (an "MABR unit") in water comprising ammonia;

providing a gas comprising oxygen ("process air") to the inside of the MABR unit; and,

growing a population of bacteria on the outside of the MABR unit wherein the bacteria include ammonia oxidizing bacteria (AOB),

wherein the process comprises one or more of:

- batch feed of process air in cycles having a cycle time of the batch feed of process air is between 0.1 and 2 hours;
- process air modulation in repeated cycles having a cycle time between 0.5 and 10 days;
- process air direction reversal wherein process air flows in one direction through the MABR unit for a first period of time, and then flows in the opposite direction through the MABR unit for a second period of time;
- process air nitrogen enrichment wherein nitrogen enriched air is provided to the MABR unit:

  wherein the nitrogen enriched air is provided by process air recycle, comprising flowing at least some exhaust gas from an outlet of the MABR unit into an inlet of the MABR unit; or

  wherein a first process air flow is provided to the MABR unit for a first period of time and a second, relatively nitrogen enriched, process air flow is provided to the MABR unit for a second period of time and wherein the second process air flow rate is higher than the first process air flow rate;

- ;process air flow in series between a plurality of MABR units, wherein process air is provided to the plurality of MABR units in series by connecting a port of one MABR unit to a port of another MABR unit; and,
- maintaining an exhaust air oxygen concentration below 4%.

2. The process of claim 1 comprising the batch feed of process air in a cycle wherein air is provided to the MABR unit for a third period of time and then valves are closed upstream and downstream of the MABR unit for a fourth period of time.

3. The process of claim 1 comprising the process air modulation wherein process air is provided to the MABR unit at a first rate for a third period of time and at a second rate for a fourth period of time.

4. The process of claim 1 wherein a total cycle time of the process air direction reversal is between 0.5 and 10 days.

5. The process of claim 1 comprising the process air nitrogen enrichment wherein a total cycle time is between 0.5 and 10 days long.

6. The process of claim 1 comprising the process air flow in series wherein each MABR unit is less than 0.5 m long, or wherein the MABR units is in series are more than 1 m long.

7. The process of claim 1 comprising the process air flow in series combined with at least one of the batch feed of process air in cycles, the process air modulation, the process air direction reversal, and the process air nitrogen enrichment.

8. The process of claim 1 comprising process air direction reversal combined with at least one of the batch feed of process air in cycles, the process air modulation, the process air flow in series, and the process air nitrogen enrichment.

9. The process of claim 1 wherein MABR exhaust has an oxygen concentration of 2% or less.

10. The process of claim 1 comprising a combination of a) one or more of: process air flow in series; process air batch feed; process air modulation; and, process air nitrogen enrichment with b) process air direction reversal.

11. An MABR comprising an MABR unit and one or more of: conduit networks; gauges; valves; sensors; and, flow control devices, configured for providing process air to the MABR unit according to a process of any of claims 1 to 10.

12. The process of claim 1 wherein the first process air is ambient air.