Belgian inspection method for soil-disinfection machines.

Johan Declercq & David Nuyttens
ILVO – Technology & Food Science Unit – Agricultural Engineering

Guillaume Defays & Bruno Huyghebaert
Agricultural Research Centre (CRA-W) – Agricultural Engineering Department

SPISE 5 : 15/10/2014
Soil disinfection machine: Working principle

**AIR PRESSURE PART**
1) Compressor with air filter
2) Air pressure tank
3) Air pressure gauge air tank
4) Pressure shutoff valve
5) Pressure regulator
6) Air pressure gauge pesticide tank
7) Pressure relief valve
8) Depressurizing valve
(or 1-5 = scuba tank with regulator)

**LIQUID PART**
9) Pesticide filling valve
10) Pesticide tank
11) Filter (optional)
12) Flowmeter (optional)
13) Main valve
14) Flow regulator (optional)
15) Section/dividing block
16) Pesticide pressure gauge (optional)
17) Injectors
Soil disinfection machines: Problems

- Hazardous products:
  - DD-telone (1,3-Dichloropropene)
  - Monam (metam-natrium)
  - Chloropicrin (toxic gas used in WW I)

→ Guidelines & measures to protect inspectors needed!

- Very small number of machines:
  - Time consuming (method, software, ...)
  - Impossible to divide all costs over 17 machines...

→ Economic approach needed!

- New items to be inspected/other limits!
  - Pressurization of the tank
  - Injector pattern check
  - ...

→ New inspection protocol/methods
Hazardous products

Guidelines for personnel protection of inspectors:

- Wear the necessary protective equipment :
  → Mask with active carbon filter !!!
  → Gloves (CAT III)
  → Steel toe shoes
- Inspection in open air !
- Put the machine downwind !

Safety conditions to admit the machines to the inspection:

- PTO or other moving parts have to be protected
- Clean and rinsed

*But: inside cleaning is difficult (closed tank and no rinsing systems.)*
Very small number of machines

A lot of work/costs for only 17 machines:

- **Using existing or cheap test equipment.**
  - → No large additional costs
  - → No additional calibration (ISO17020, training,...)

- **All inspections performed by one team.**
  - → Training for one team
  - → Possible to build up more experience
  - → Extra protective equipment only for one team
  - → Extra test equipment only for one team

- **Grouping the inspections in 2 or 3 days every 3 years.**
  - → Refresher training every 3 years
  - → Once every 3 years checking the dedicated material:
    - Active carbon filter,
    - Small buckets,
    - ....
Inspection part 1: admittance and starting up

CHECK IF ADMITTANCE RULES ARE FULLFILLED:

- Machine has to be presented in a pressurized state.
- Filled with ¾ clean water and clean state.
- No big leakages.
- Solid connection of machine to the tractor.
- PTO and other moving parts protected.

OK

N

Y

REFUSED!!
=Reconvocation
+extra fee
Inspection part 2: During injection

**E: Pressure stability:** checking while machine is injecting/spraying at normal working pressure during 1 minute without changing the settings of the machine.

→ Limit Cl2: Pressure fluctuation >10%

**J: Compressor:** Functioning

→ Limit Cl2: Air capacity is insufficient, unable to maintain work pressure.

**I1+I2: Leaks while injecting:** Detecting big (I1) and/or small (I2) leakages.

→ Limit Cl1 or Cl2: Big >30ml/min

**F1: Presence of a measuring device:**

→ Limit Cl1: Not present. (pressure gauge and/or flowmeter)

**F2: Visibility of the measuring device:**

→ Limit Cl3: Not readable from operators position.
Inspection part 2: During injection

H Control and regulation system:
H1: Electronical regulation: function check of the automatic regulation system.
   → Limit Cl2: Difference >10% between set and measured value.
H2: Control valves: function check of all control valves.
   → Limit Cl2: one or more valves don’t shut off.
H3: Pressure and/or flow controls:
   - Vary pressure with 1 bar from normal work pressure
     → Limit Cl2: Impossible to vary the pressure.
   - Shutting off and on main valve.
     → Limit Cl2: pressure variation >10%
Inspection part 3: measuring injector pattern

TWO MACHINE TYPES

3a: MACHINES WITH TUBE INJECTOR:
- Flow determined by pressure and:
  - section block with calibrated plates or small taps or
  - tube diameter

3b: MACHINES WITH NOZZLE INJECTOR:
- Flow determined by pressure and nozzle size
Inspection part 3: defining injector pattern

TWO MACHINE TYPES

3a : MACHINES WITH TUBE INJECTOR:
- Positioning a similar bucket (same tare) underneath each injector.
- One weighing scale and a stopwatch

3b : MACHINES WITH NOZZLE INJECTOR:
- Nozzle flow measurement with orchard nozzle test bench on machine and a stopwatch

Pattern OK?:

Y → OK
N → Rejected bad pattern

Nozzle OK?:

Y → OK
N → Rejected bad pattern and worn nozzles
Inspection part 3: defining injector pattern

G8-G9: Pattern uniformity limits:
Limit Cl1: Individual injector flowrate differs more than 10% from average flowrate of all injectors. (Symmetry allowed.)

G2-G7: Optional nozzle test: Only when pattern rejected.
→ Limits Cl1:
  - Flat fan nozzles: average flow >5% nominal flow
  - Other nozzles: average flow >10% from nominal flow
  - Size unknown: individual flow >5% from average

F4: Flowmeter test:
→ Limit Cl2: Flowrate or counted flow value indicated on the flowmeter differs more than 10% from the measured value.
Inspection part 4: Depressurised inspection

A1: General maintenance condition:

→ Limit Cl3: visual signs of bad maintenance

A2: Protection of moving parts:

→ Limit Cl2: Bad state, not present

A3: Safe depressurizing and safety valve:

Pesticide tank is depressurised

→ Limits Cl2:

- Unsafe depressurization.
- Filling valve can be opened accidentally.
- No pressure relief valve

F3: Pressure gauges: tested on a manometer teststand

→ Limit Cl2: difference >10%
Inspection part 4: Depressurised inspection

B: Tank contents indicator:
- Limits Cl3: B1 present and B2 readability

C: Filter presence and condition:
- C1+C2: Pressure filter
- C3+C4: Nozzle filter
- C5+C6: Pneumatic filter
  - Limits: Present Cl1 (if relevant) and state Cl2 (if present)

D: Ploughshares:
- D1: Uniformity → Limit Cl2 not uniform
- D2: Protection of injector tubes → Limit Cl2 not properly protected
Remember: YOLO

! Bear in mind to wear protective equipment!

Thanks for your attention.

Contact & info:
Johan.declercq@ilvo.vlaanderen.be
www.ilvo.vlaanderen.be\keuringspuittoestellen & www.ilvo.vlaanderen.be\spraytechlab

Institute for Agricultural and Fisheries Research
Technology and Food Science Unit

‘Agricultural Engineering’ and ‘Product Quality and Innovation’ Research Areas
Burg. Van Gansberghelaan 115 box 1
9820 Merelbeke
T +32 9 272 28 00

www.ilvo.vlaanderen.be