FERTIGATION AND USE OF DEGRADED WATER

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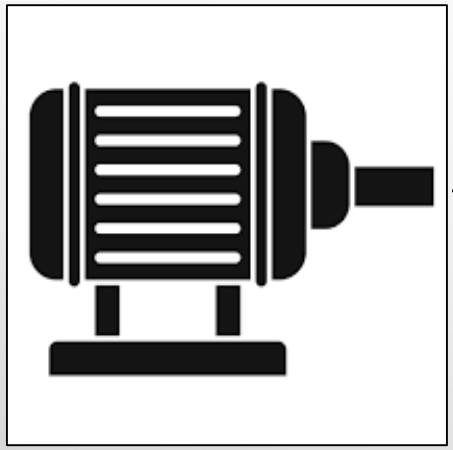
FERTIGATION INTRO

- APPLICATION OF SOLUBLE FERTILIZER THROUGH AN IRRIGATION SYSTEM
- BEST SUITED TO PRESSURIZED SYSTEMS (SPRINKLER AND DRIP)
  - ACCURATE DOSING/INJECTION OF FERTILIZER
  - HIGHER UNIFORMITY AND EFFICIENCY OF APPLICATION
    - LESS RUNOFF OR LEACHING LOSSES OF CHEMICALS TO SURFACE AND GROUND WATER
    - LESS PATTERNING OF APPLICATION
  - EASIER FILTRATION AND/OR PRETREATMENT OF WATER IF NEEDED (THE “DEGRADED” ASPECT)
- CAN SAVE ON COSTS:
  - LESS FERTILIZER OFTEN REQUIRED
  - BETTER TIMING TO CROP NEED
  - LESS LABOR AND EXPENSE OF ADDITIONAL FERTILIZATION OPERATIONS

TYPICAL FERTIGATION SYSTEM DESIGN



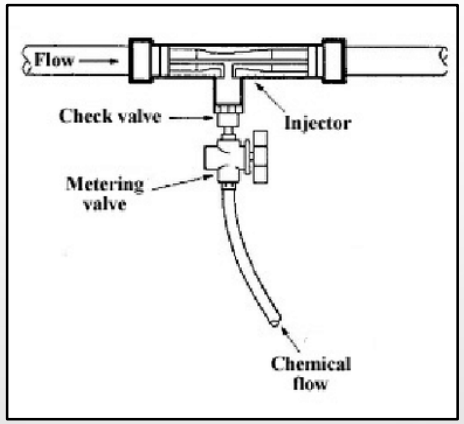
Pump/Water Source

Backflow valve

Pre-Treatment

(filtration, pH adjustment, etc.)

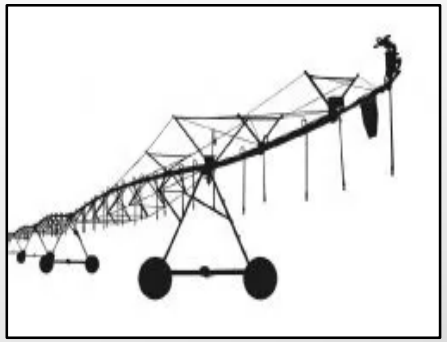
Fertilizer Injection



(chosen based on design objective)

Post Filtration

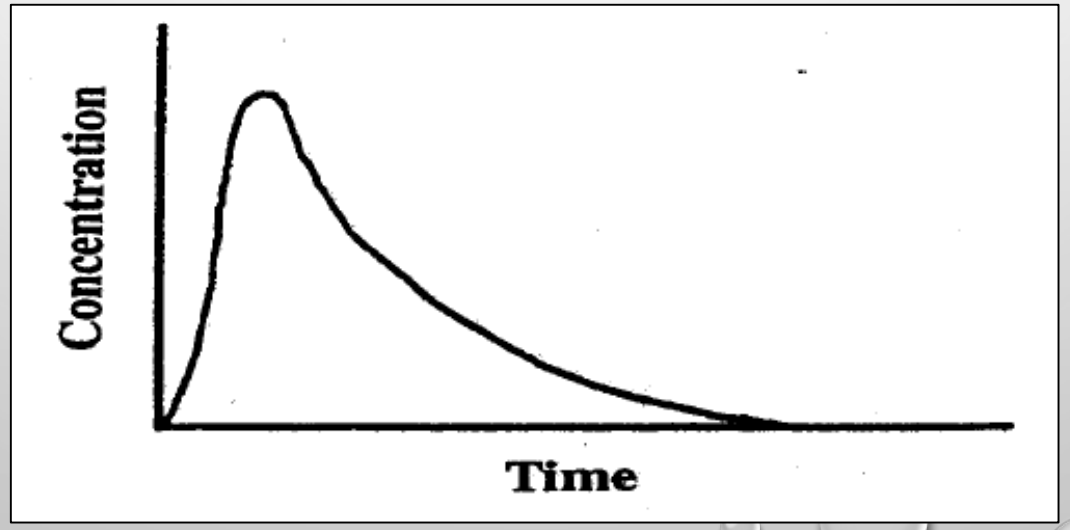
(final water conditioning)



Main Line - Delivery

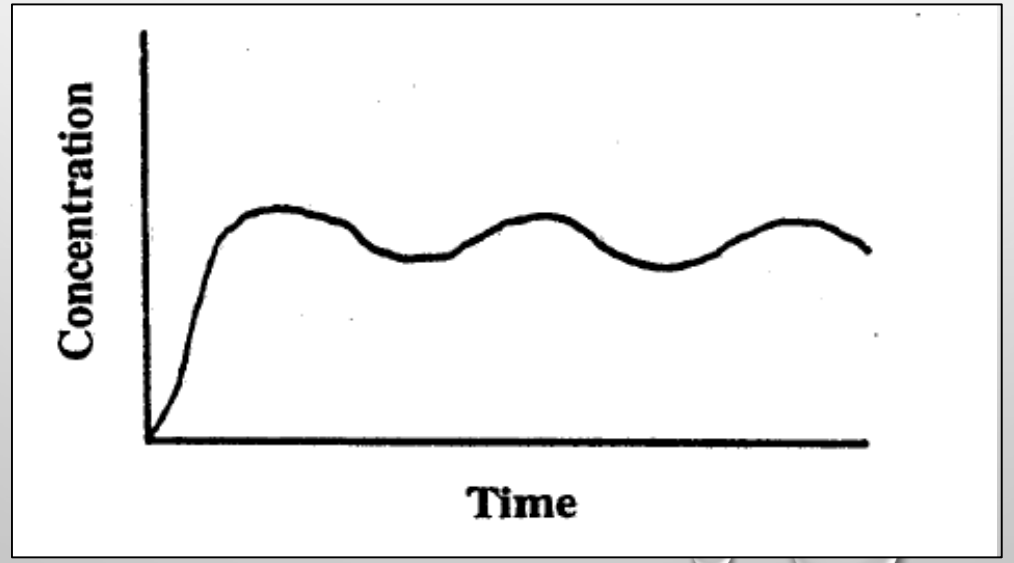
FERTILIZER INJECTION

- THREE MAIN TYPES – PRESSURE TANK, VENTURI TYPE, AND DIRECT DISPLACEMENT
- **PRESSURE TANK**
  - PRESSURE AND SMALL PORTION OF FLOW SIPHONED OFF MAIN LINE INTO TANK, WATER MIXES WITH AND DILUTES STOCK SOLUTION FROM TANK BACK INTO MAIN LINE.
  - NOT WELL-SUITED TO SELF-MOVING SPRINKLERS (PIVOTS AND LINEARS) SINCE CONCENTRATION OF FERTILIZER IS NOT CONSTANT. USED FOR SOLID SET, SIDE-ROLL AND DRIP SYSTEMS.
  - DESIGNED TO DELIVER SET ***AMOUNT*** OF MATERIAL TO A SPECIFIC AREA OVER TIME



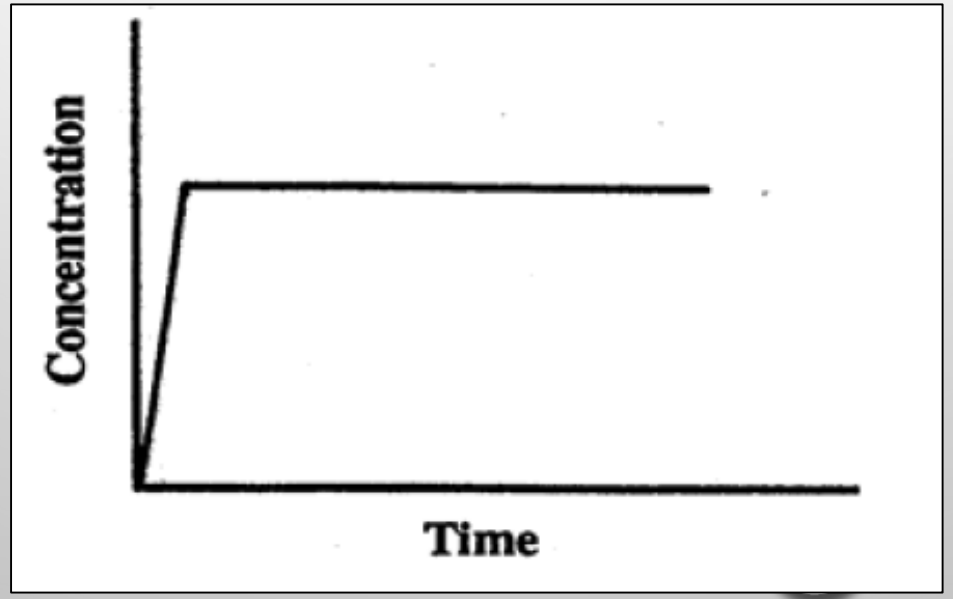
FERTILIZER INJECTION

- **VENTURI TYPE**
  - PRESSURE DIFFERENTIAL CAUSED BY FLOW RESTRICTION THROUGH INJECTOR CAUSES SUCTION TO DRAW FERTILIZER MATERIAL INTO MAIN LINE.
  - CONCENTRATION MORE STABLE OVER TIME, BUT MAY VARY WITH PRESSURE FLUCTUATIONS IN SYSTEM (FRICTION REQUIRES ACCOUNTING FOR PRESSURE LOSS IN SYSTEM)
  - DESIGNED TO DELIVER TARGET ***CONCENTRATION*** OF MATERIAL FOR A SPECIFIED LENGTH OF TIME TO AN AREA



FERTILIZER INJECTION

- **DIRECT DISPLACEMENT OR DIRECT INJECTION**
  - ELECTRIC, GAS OR HYDRAULIC PUMP-TYPE INJECTOR THAT PRECISELY METERS FERTILIZER STOCK INTO MAIN LINE
  - CONCENTRATION VERY STABLE OVER TIME (HYDRAULIC INJECTORS ARE RHYTHMIC DIRECTLY WITH MAIN LINE FLOWS)
  - DESIGNED TO DELIVER SET ***CONCENTRATION*** OF MATERIAL FOR A SPECIFIED TIME TO AN AREA



FACTORS TO CONSIDER BEFORE FERTIGATION

- FERTILIZER INCOMPATIBILITIES (BETWEEN TWO OR MORE MATERIALS, INCL. IRRIGATION WATER) – FIRST STEP ALWAYS!
- WATER QUALITY "DEGRADATION" FACTORS DETERMINING THE NEED FOR WATER CONDITIONING (PRE OR POST) NEED TO BE EVALUATED TO PRE-DETERMINE LIKELIHOOD OF PROBLEMS
  - PHYSICAL FACTORS
    - SUSPENDED SOLIDS AND DEBRIS
  - BIOLOGICAL FACTORS
    - BACTERIA AND ALGAE LOADS
  - CHEMICAL FACTORS
    - PH, SALINITY/TDS/HARDNESS, BICARBONATE, MN, FE, AND HYDROGEN SULFIDE

ALWAYS CHECK FERTILIZER/FERTILIZER AND FERTILIZER/WATER COMPATIBILITY FIRST

- MANY COMMON FERTILIZERS, OTHERWISE SOLUBLE IN A GIVEN WATER, MAY PRECIPITATE IN THE PRESENCE OF OTHER CHEMICALS
  - EG., AMMONIUM PHOSPHATE LIQUID FERTILIZER (HIGHLY SOLUBLE IN WATER) CAN REACT RAPIDLY IN HIGH PH, HARD WATER TO FORM CA-MG-PHOSPHATE, OR APATITE, A HIGHLY INSOLUBLE PRECIPITATE THAT CAN CLOG LINES, NOZZLES AND DRIPPERS
  - EG., UREA HYDROLYSIS CAN INCREASE PH OF ALKALINE WATER TO VALUES ABOVE 8.0, AND RENDER SOLUBLE IRON IN WATER, INSOLUBLE AND FORM IRON CARBONATES IN SPRINKLER NOZZLES AND DRIPPERS
  - I ONCE MIXED A LARGE QUANTITY OF ZINC SULFATE SOLUTION AND GREEN PHOSPHORIC ACID AND HAD TO SPEND TWO DAYS CLEANING OUT A FERTILIZER SPRAYER FROM THE ZINC PHOSPHATE CRYSTALS THAT FORMED.
- FIRST ORDER IS TO RUN SIMPLE “JAR TEST” TO ENSURE SOLUTION COMPATIBILITY (BEST DONE AT THE TEMPERATURE OF THE WATER DIRECTLY OUT OF THE IRRIGATION SOURCE).

Determining clogging hazard for various levels of water degradation

	Hazard level		
Problem	**Low**	**Moderate**	**Severe**
Physical			
Suspended solids (ppm)	< 50	50–100	> 100
Chemical			
pH	< 7.0	7.0–8.0	> 8.0
Salt (ppm)	< 500	500–2000	> 2000
Biocarbonate (ppm)	< 100	100	> 100
Manganese* (ppm)	< 0.1	0.1–1.5	> 1.5
Total iron* (ppm)	< 0.2	0.2–1.5	> 1.5
Hydrogen sulfide (ppm)	< 0.2	0.2–2.0	> 2.0
Biological			
Bacterial population per gallon	< 2642	2642–13210	> 13210
Note: When testing for iron and manganese, the water sample needs to be acidified to a pH of 3.5 immediately after sampling. Source: Bucks and Nakayama (1980); Burt, O'Connor, and Ruehr (1995)			

PRE-CONDITIONING DEGRADED WATER

- IN MODERATE TO SEVERE CONDITIONS (PREVIOUS TABLE) CONSIDER:
  - PHYSICAL FACTORS – FILTRATION AHEAD OF FERTILIZER INJECTION TO REMOVE CLAY, ORGANIC DEBRIS, ALGAE, ETC. THAT CAN FOUL SYSTEMS.
    - SIMPLE DEBRIS – CYCLONIC, SCREEN AND DISC FILTERS WORK WELL
    - CLAY AND ALGAE – SAND MEDIA FILTRATION IS BETTER
  - BIOLOGICAL FACTORS – CHLORINATION AND/OR ACIDIFICATION
  - CHEMICAL FACTORS – ACIDIFICATION, SOFTENING, PRECIPITATION AND FILTRATION

POST FERTIGATION CONDITIONING

- FINAL FILTRATION TO REMOVE ANY PRECIPITATE THAT MAY FORM, OR REMOVE ANY PASS THRU SOLIDS FROM PRE-TREATMENT.
- ADDITIONAL ACIDIFICATION OR CHEMICAL ADJUSTMENT MAY ALSO BE NECESSARY

FURTHER READING

- LIU AND MCAVOY 2018. HOW TO REDUCE CLOGGING PROBLEMS IN FERTIGATION. U OF FL EXTENSION BULLETIN #HS1202.
- DEPT OF PRIMARY INDUSTRIES, NEW SOUTH WALES AUSTRALIA. 2014. FARM WATER QUALITY AND TREATMENT. PRIMEFACT BULLETIN #1337.
- SCHWANKL, LAWRENCE J. FERTIGATION. 2014. CH. 12 IN FERGUSON AND GRAFTO-CARDWELL (EDS) CITRUS PRODUCTION MANUAL. UNIV OF CA DAVIS PUBLICATION #3539