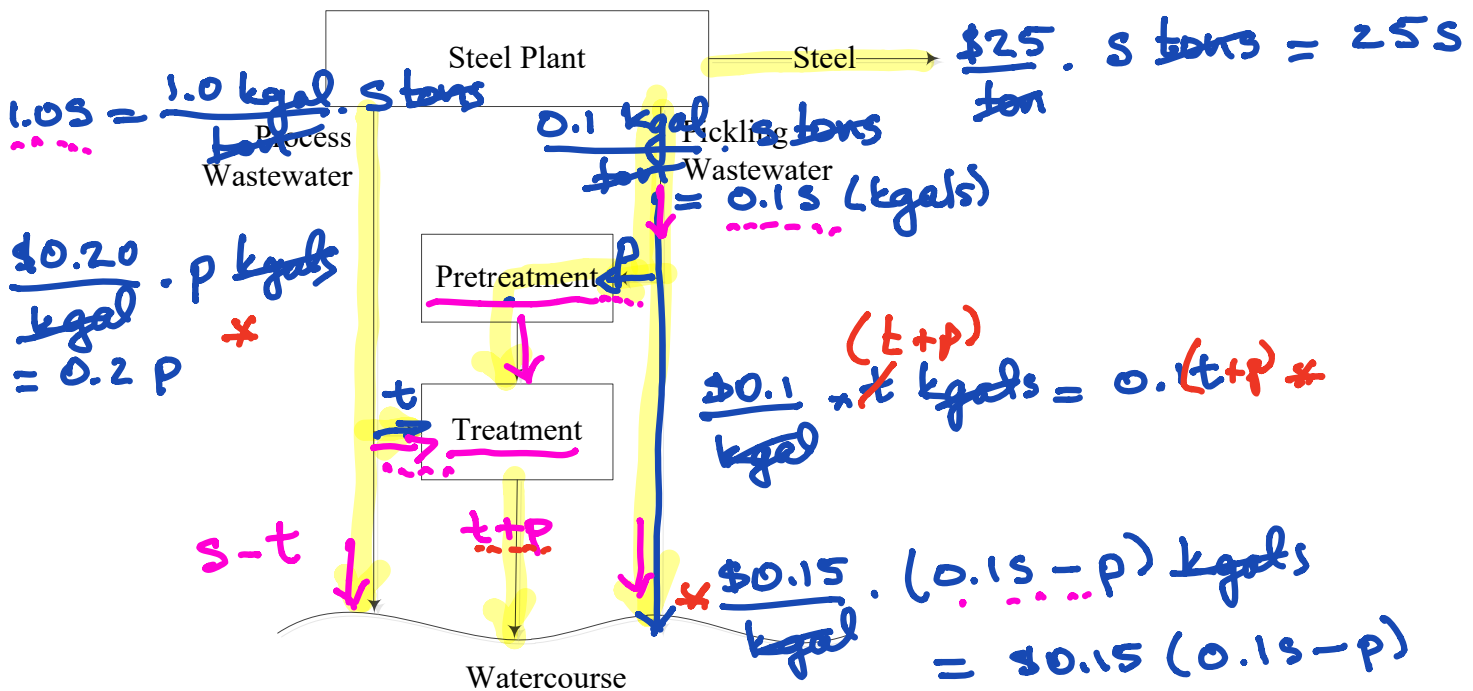


Linear Programming Example: Wastewater Treatment

A rolling mill in a steel plant produces steel but also two kinds of wastewater: process water and pickling wastes. These wastes can either be discharged directly into a water course without treatment but subject to an effluent tax, or alternatively may be treated in an existing plant that removes 90 percent of the objectionable materials. The process wastewater can go directly into the treatment process, but pickling wastes require neutralization pretreatment before being treated. The system can be visualized like this:

$$\text{Max profit: } p = R - C$$

$$= 25s - (0.2p + 0.15(0.1s - p) + 0.1(t + p))$$



$$p = 25s - (0.2p + 0.15(0.1s - p) + 0.1(t + p))$$

$$= 24.985s - 0.15p - 0.1t$$

Here are some data about the system (not current, this data is circa 1970):

- Income on steel manufactured: \$25/ton ✓
- Pickle waste generated: 0.1 thousand gallons/ton of steel ✓
- Process water generated: 1.0 thousand gallons/ton of steel ✓
- Cost of pretreating pickle waste: \$0.20/thousand gallons ✓
- * Cost of treatment: \$0.10/thousand gallons ✓
- Effluent tax on untreated pickle waste: \$0.15/thousand gallons ✓
- Pretreatment plant capacity: 2,000,000 gallons/day ✓ $p \leq 2,000 \text{ kgal}$
- Treatment plant capacity: 50,000,000 gallons/day ✓ $t + p \leq 50,000 \text{ kgal}$
- Treatment plant efficiency: 0.90 ?
- Regulations prohibit more than 500,000 gal/day of pickle waste or more than 10,000,000 gal/day of process water being discharged without treatment. ✓ $0.1s - p \leq 500 \text{ kgal}$
 $s - t \leq 10,000 \text{ kgal}$