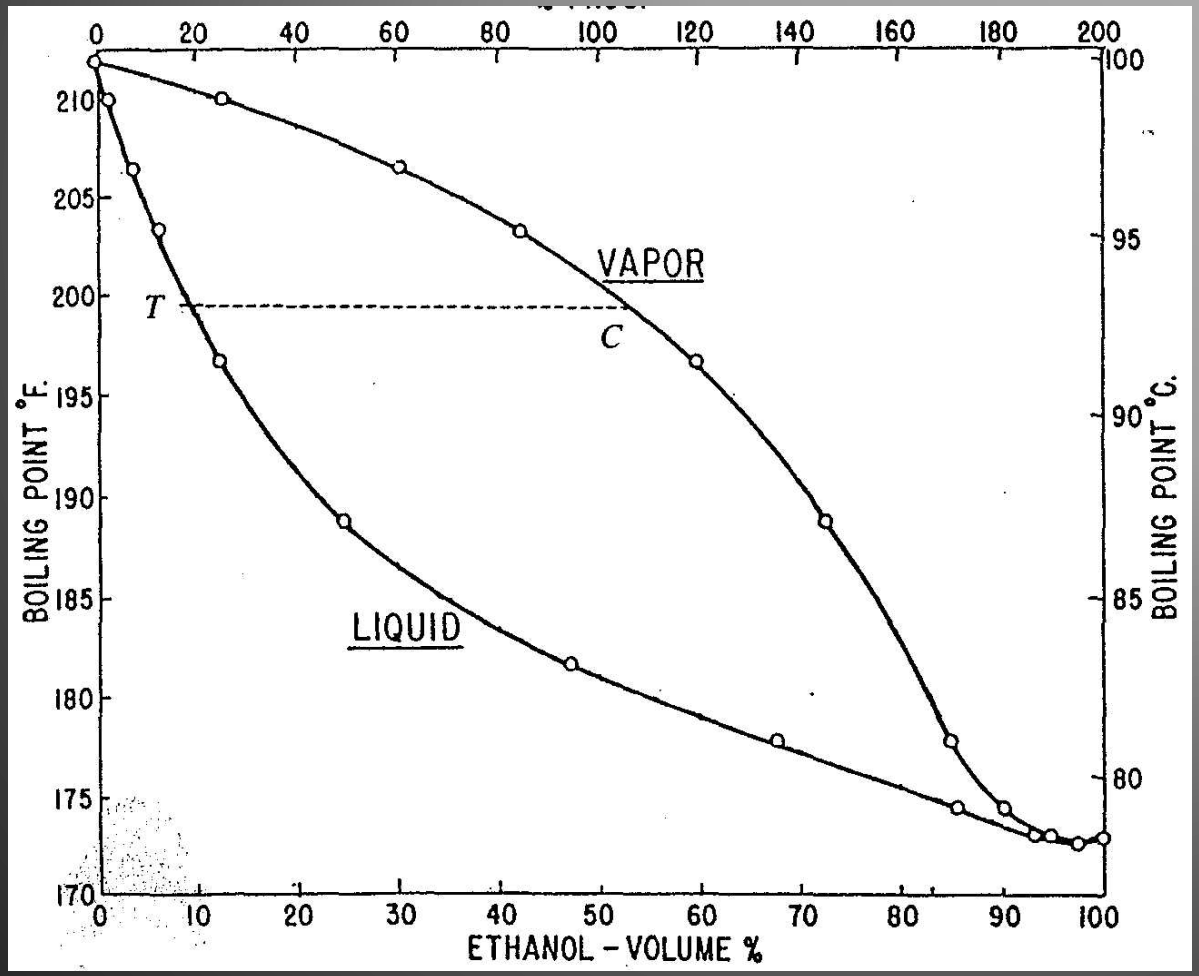
Determination of Alcohol Content

- Table Wines
  - Contain 7 – 14% ethanol
- Dessert Wines
  - Contain 14 – 24% ethanol

Determination of Alcohol Content

- Physical Methods
  - Ebulliometry
  - Distillation plus Refractometry
  - Distillation plus Hydrometry
  - Gas Chromatography
- Chemical Methods
  - Enzymatic Analysis
  - Dichromate Oxidation

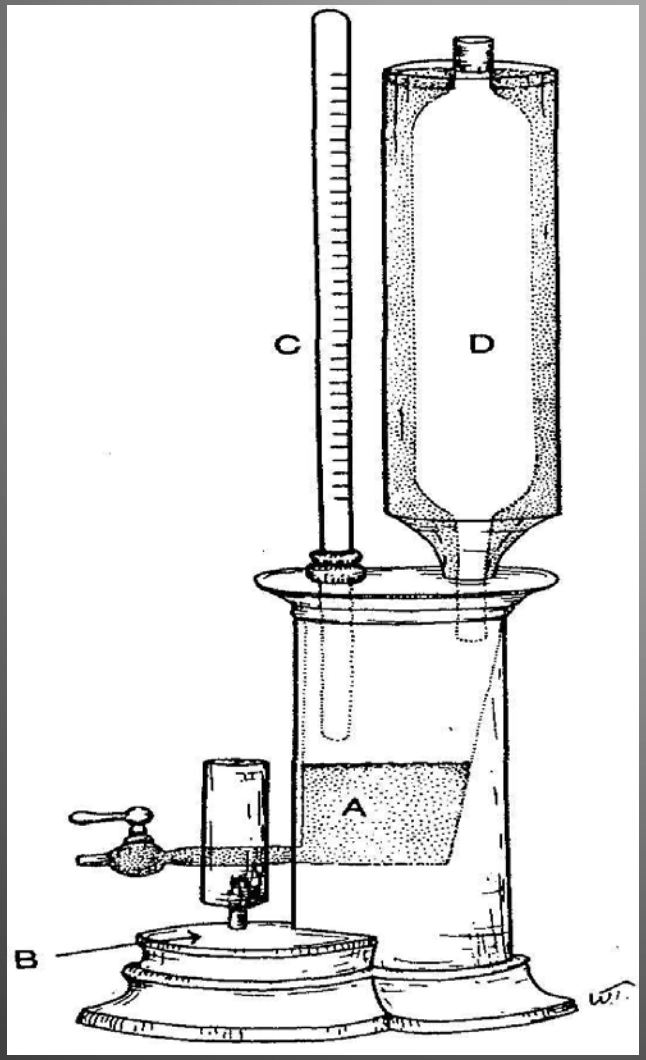
Ethanol Boiling Point Diagram



Ebulliometry

- Boiling point vs. ethanol concentration
  - Non-linear relationship
- Vapor composition associated with boiling liquid composition
  - Total reflux for accurate boiling point
  - Sugar errors

Ebulliometer



EBULLIOMETRIC ETHANOL

- Equipment:
- Ebulliometer, mercury thermometer (°C), alcohol slide rule scale
- Deionized water and cold tap water source
- alcohol lamp
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- Reagents
- Sodium Hydroxide (1%) Cleaning Solution: Dissolve 10 g of sodium hydroxide in 990 mL tap water. Identify as "Ebulliometer Cleaning Solution.' "

EBULLIOMETRIC ETHANOL

- **Determine boiling point of water**
- Add approximately 30 mL of deionized water to boiling chamber "A." There is no need to add cold tap water to condenser "D" at this time.
- Insert thermometer "C." Position instrument over flame.
- When thermometer reaches a stable point, allow 15-30 sec for minor fluctuations to occur. At this time, take boiling point reading and set inner scale opposite 0.0% alcohol on the "Degres Alcoholique Du Vin" outer scale.

EBULLIOMETRIC ETHANOL

- **Determine boiling point of wine**
- Rinse boiling chamber with a few milliliters of wine to be analyzed and drain (This prevents dilution of sample).
- Dilute 50 mL of wine to 100 mL in a volumetric flask. Place approximately 50 mL of wine in boiling chamber.
- Fill condenser with cold tap water
- Insert thermometer such that it is partially immersed in the liquid, and place instrument over heat source.

EBULLIOMETRIC ETHANOL

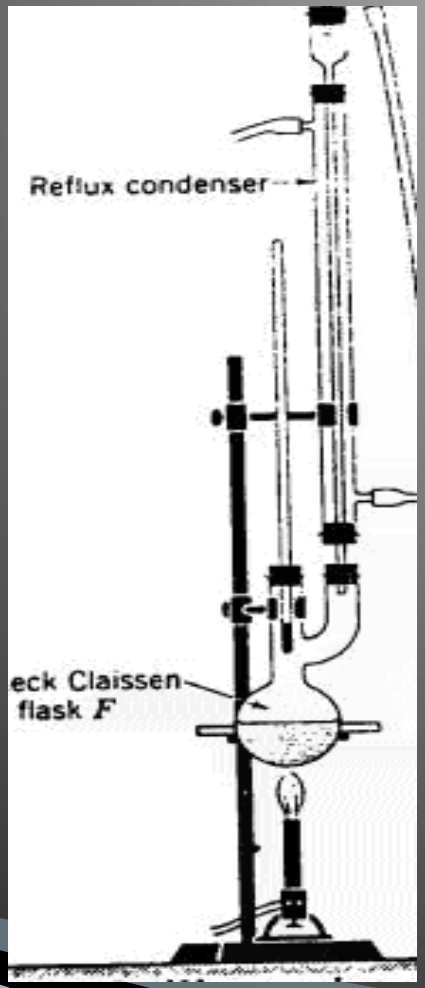
- **Determine boiling point of wine**
- When thermometer reaches a stable level, allow 15-30 sec for changes and take reading.

- Locate the boiling point of wine on the inner "Degres du Thermometre" scale and record the corresponding alcohol content (% vol/vol) on the outer scale.

Ebulliometric Temperature Difference Readings vs. % Ethanol

%Ethanol	Delta T	%Ethanol	Delta T	%Ethanol	Delta T	%Ethanol	Delta T	%Ethanol	Delta T	%Ethanol	Delta T	%Ethanol	Delta T
0.00	0.00	2.10	1.96	4.60	4.01	7.10	5.79	9.60	7.32	12.10	8.71	14.60	9.91
0.01	0.05	2.20	2.05	4.70	4.09	7.20	5.87	9.70	7.39	12.20	8.77	14.70	9.95
0.10	0.10	2.30	2.13	4.80	4.16	7.30	5.91	9.80	7.44	12.30	8.82	14.80	10.01
0.15	0.14	2.40	2.22	4.90	4.22	7.40	5.99	9.90	7.51	12.40	8.87	14.90	10.04
0.20	0.20	2.50	2.31	5.00	4.31	7.50	6.05	10.00	7.57	12.50	8.92	15.00	10.09
0.25	0.24	2.60	2.41	5.10	4.39	7.60	6.11	10.10	7.61	12.60	8.97	15.10	10.12
0.30	0.30	2.70	2.50	5.20	4.45	7.70	6.18	10.20	7.68	12.70	9.02	15.20	10.17
0.35	0.34	2.80	2.59	5.30	4.52	7.80	6.24	10.30	7.73	12.80	9.07	15.30	10.21
0.40	0.39	2.90	2.68	5.40	4.59	7.90	6.30	10.40	7.79	12.90	9.12	15.40	10.26
0.50	0.49	3.00	2.76	5.50	4.68	8.00	6.37	10.50	7.85	13.00	9.18	15.50	10.30
0.60	0.58	3.10	2.83	5.60	4.73	8.10	6.41	10.60	7.91	13.10	9.21	15.60	10.33
0.70	0.67	3.20	2.91	5.70	4.81	8.20	6.49	10.70	7.97	13.20	9.26	15.70	10.38
0.80	0.77	3.30	3.01	5.80	4.89	8.30	6.54	10.80	8.01	13.30	9.31	15.80	10.42
0.90	0.85	3.40	3.09	5.90	4.96	8.40	6.60	10.90	8.08	13.40	9.36	15.90	10.47
1.00	0.94	3.50	3.18	6.00	5.02	8.50	6.66	11.00	8.12	13.50	9.41	16.00	10.50
1.10	1.03	3.60	3.25	6.10	5.10	8.60	6.72	11.10	8.19	13.60	9.46	16.10	10.53
1.20	1.12	3.70	3.32	6.20	5.18	8.70	6.79	11.20	8.23	13.70	9.51	16.20	10.59
1.30	1.22	3.80	3.41	6.30	5.23	8.80	6.84	11.30	8.29	13.80	9.56	16.30	10.63
1.40	1.31	3.90	3.49	6.40	5.31	8.90	6.91	11.40	8.35	13.90	9.61	16.40	10.67
1.50	1.41	4.00	3.58	6.50	5.39	9.00	6.97	11.50	8.40	14.00	9.64	16.50	10.70
1.60	1.50	4.10	3.64	6.60	5.46	9.10	7.02	11.60	8.45	14.10	9.69	16.60	10.74
1.70	1.59	4.20	3.71	6.70	5.52	9.20	7.09	11.70	8.51	14.20	9.73	16.70	10.79
1.80	1.69	[illegible]	3.80	6.80	5.59	9.30	7.14	11.80	8.57	14.30	9.79	16.80	10.82
1.90	1.79	4.40	[illegible]	6.90	5.66	9.40	7.21	11.90	8.61	14.40	9.82	16.90	10.87
2.00	1.88	4.50	3.93	[illegible]	[illegible]	9.50	7.28	12.00	8.67	14.50	9.88	17.00	10.90

Lab Glassware Ebulliometer

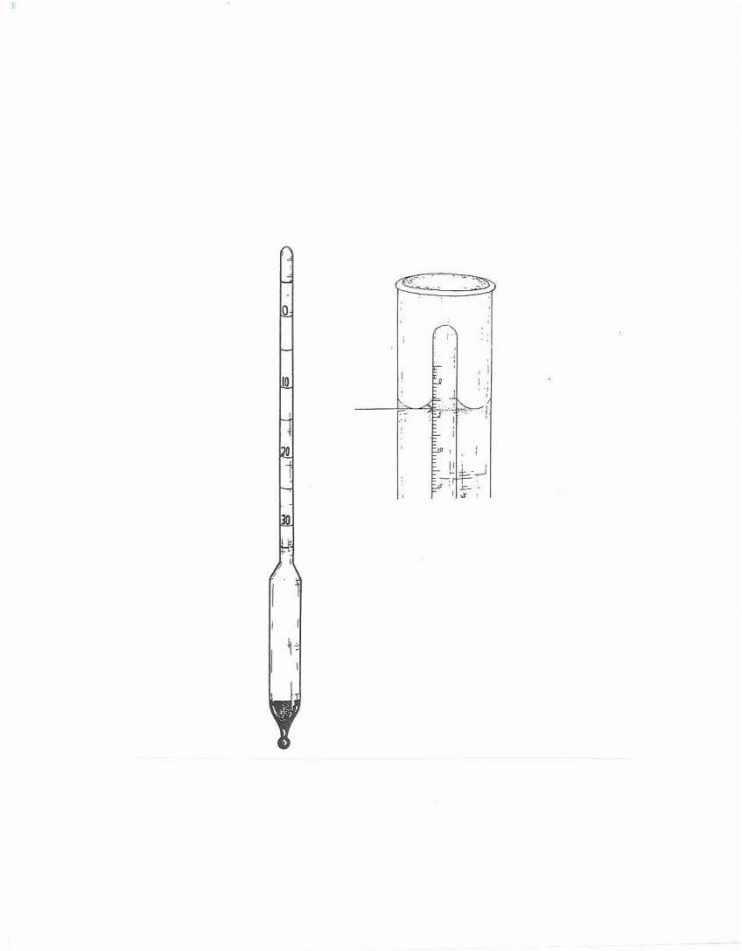


Distillation

- Vapor ethanol concentration vs. solution concentration

- Concentration change during distillation
  - Large volume distillation to completely remove ethanol from sample

Distillation + Hydrometry for Alcohol



Distillation + Refractometry for Alcohol

- Refractive index vs. ethanol concentration
  - Procedure
  - AOAC tables

- Refractive index vs. Brix readings
  - Procedure
  - Table I – 5
  - AOAC tables

Distillation + Refractometry for Alcohol

- Refractive index vs. ethanol concentration
  - Procedure AOAC tables

	TEMP., °C								
Refractive index	17.5	18	19	20	21	22	23	24	25
1.33858	10.10	10.19	10.40	10.59	10.79	11.00	11.20	11.40	11.61
3865	10.24	10.33	10.52	10.73	10.93	11.13	11.33	11.54	11.75
3873	10.36	10.46	10.66	10.86	11.06	11.27	11.47	11.67	11.88
3881	10.50	10.59	10.79	10.99	11.20	11.39	11.60	11.81	12.01
3888	10.63	10.72	10.93	11.12	11.33	11.53	11.74	11.90	12.15

Gas Chromatography for Ethanol

- Poropak QS column
- Internal Standard
- Peak Area/Height ratios

Enzymatic & Chemical Methods

- Enzymatic ethanol
  - Kit of reagents
  - Pipetting small amounts
  - UV spectrometry

- Dichromate Oxidation method
  - Steam distillation
  - Titration

OTHER MATERIALS

- Chapter from Wine Analysis & Production
- Procedures for alcohol by Ebulliometry and Distillation/Hydrometry or Refractometry