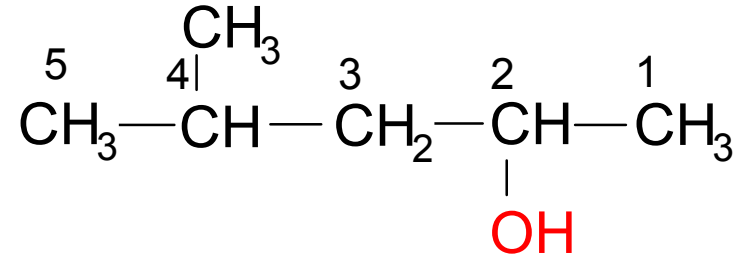


1.5. Alkohole

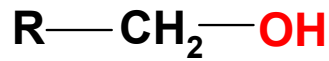
Nomenklatur: Nachsilbe **-ol**

Funktionelle Gruppe

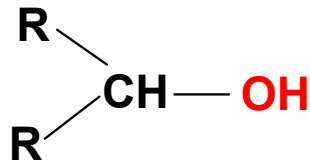
Bevorzugt benannt (vor Doppelbindungen, Alkylgruppen)



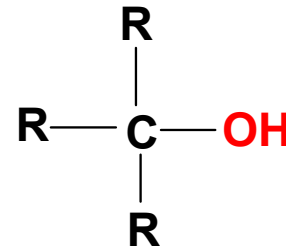
4-Methyl-pentan-2-ol



Primär



Sekundär

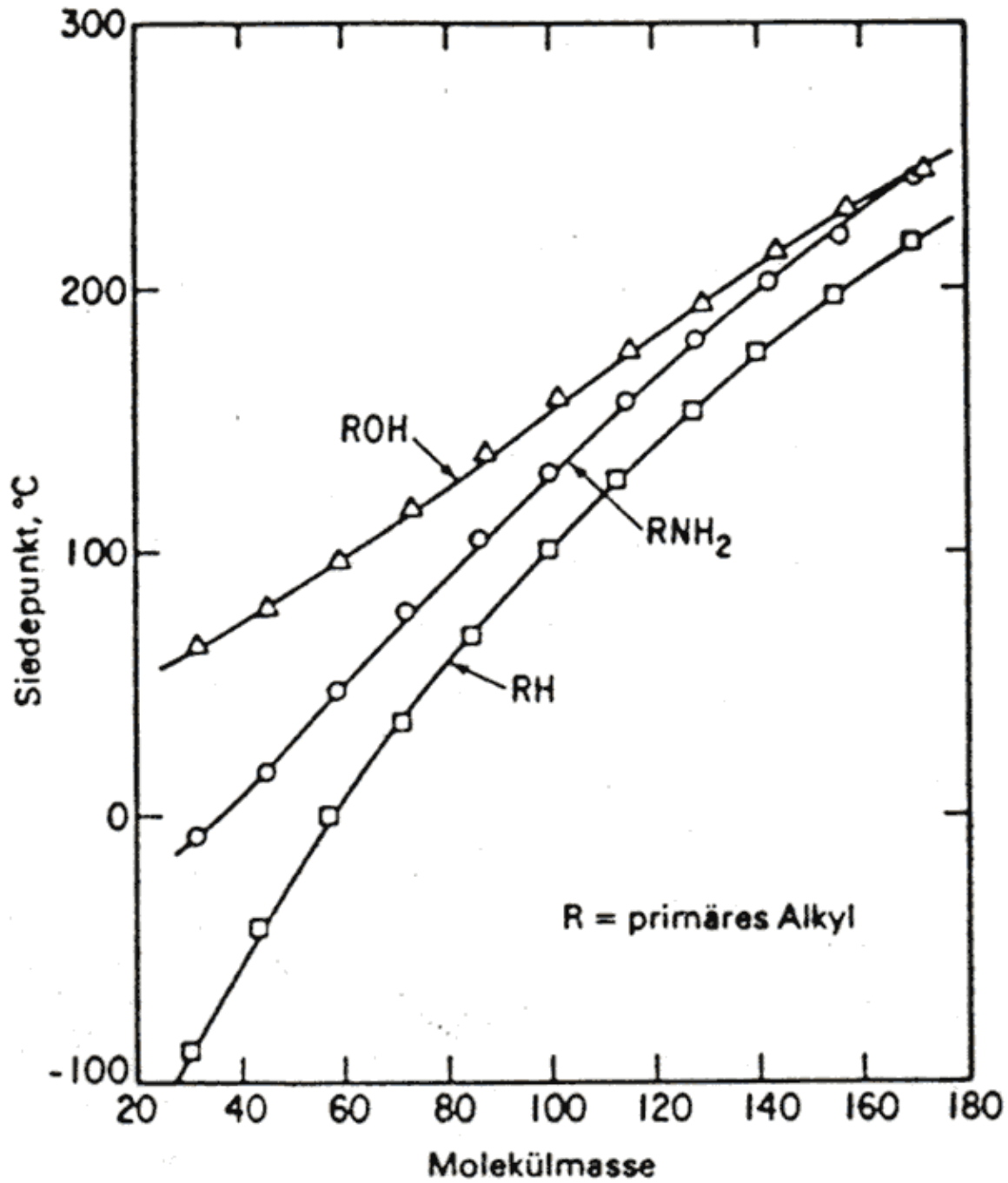


Tertiär

„Mehrwertige“ Alkohole: Di-, Tri-, Tetra-,.....Polyol

Nomenklatur und Eigenschaften einiger Alkohole

Klasse	Formel	IUPAC-Name	Trivialname [-alkohol]	Schmelzpunkt °C	Siedepunkt °C	Löslichkeit g/100g H ₂ O
aliphatisch gesättigt primär	H ₃ C - OH	Methanol	Methyl-	-97	64,5	∞
	H ₃ C - CH ₂ -OH	Ethanol	Ethyl-	-115	78,3	∞
	H ₃ C - CH ₂ - CH ₂ -OH	Propanol	<i>n</i> -Propyl-	-126	97	∞
	H ₃ C - (CH ₂) ₂ - CH ₂ -OH	Butanol	<i>n</i> -Butyl-	-90	118	∞
	H ₃ C - (CH ₂) ₃ - CH ₂ -OH	Pentanol	<i>n</i> -Pentyl-	-78,5	138	∞
	H ₃ C - (CH ₂) ₄ - CH ₂ -OH	Hexanol	<i>n</i> -Hexyl-	-52	156	7,9
	H ₃ C - (CH ₂) ₅ - CH ₂ -OH	Heptanol	<i>n</i> -Heptyl-	-34	176	2,3
	H ₃ C - (CH ₂) ₆ - CH ₂ -OH	Octanol	<i>n</i> -Octyl-	-15	195	0,6 0,2 0,05
sekundär	$\begin{array}{c} \text{H}_3\text{C} - \text{CH} - \text{CH}_3 \\ \\ \text{OH} \end{array}$	2-Propanol	<i>i</i> -Propyl-	-86	82,5	∞
	$\begin{array}{c} \text{H}_3\text{C} - \text{CH}_2 - \text{CH} - \text{CH}_3 \\ \\ \text{OH} \end{array}$	2-Butanol	<i>sec</i> -Butyl-	-114	99,5	12,5

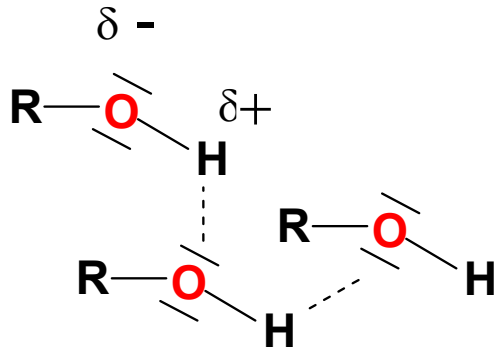


Polare Substanzen

In Lösung durch Wasserstoffbrückenbindungen assoziiert

H-Brückenbindung: 21 kJ / mol

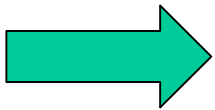
(Vgl.: O-H 431 kJ / mol)



Erhöhte Siedepunkte

Ethanol: 78 °

Ethan: -24 °



Gute Wasserlöslichkeit (C1 – C3 vollständig)

Hygroskopisch

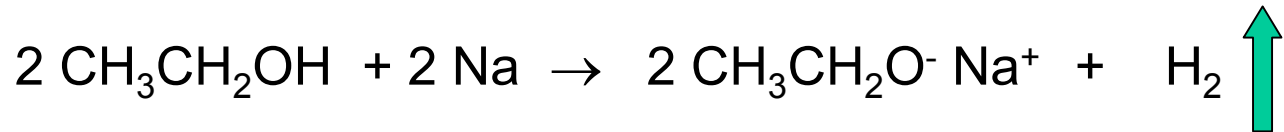
Gutes Lösevermögen für Salze

Säureeigenschaften: pKs 16

(Vgl. Wasser: pKs 16)

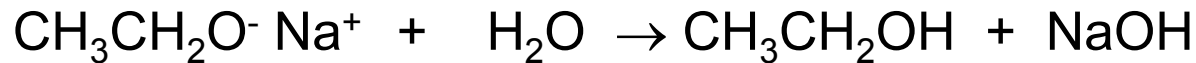
Sehr schwache Säuren

Salzbildung mit starken Basen, quantitativ mit Natrium



Salze: Alkoholate
Starke Basen

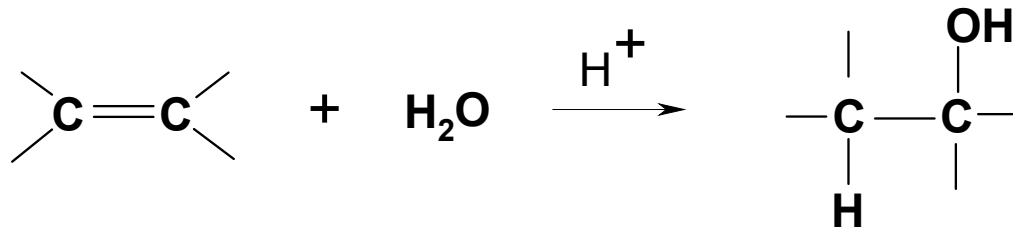
Alkoholate reagieren stark basisch



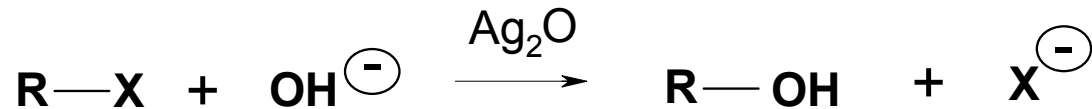
Brennwert geringer als bei vergleichbaren Alkane
(Höhere Oxidationsstufe)

Herstellung von Alkoholen

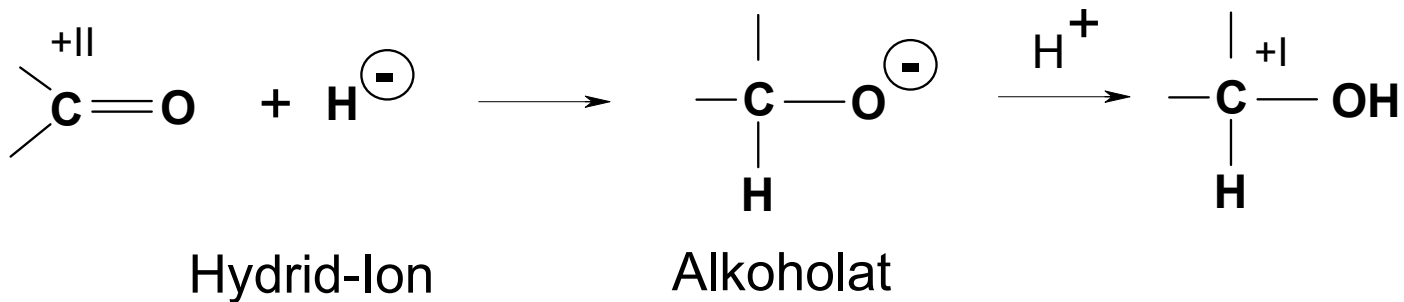
1. Aus Alkenen (Addition von Wasser an die Doppelbindung)



2. Aus Halogenalkanen (SN-Reaktion)



3. Durch Reduktion von C=O Doppelbindungen



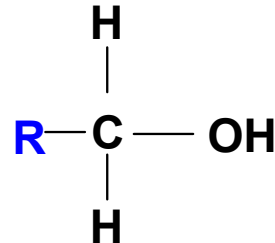
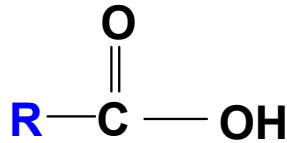
Reduktionsmittel: Wasserstoff oder komplexe Metallhydride



Lithiumaluminiumhydrid

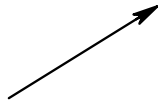
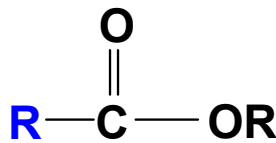
Natriumborhydrid

Carbonsäure

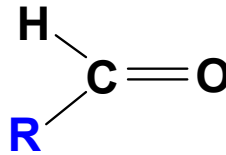


Primärer Alkohol

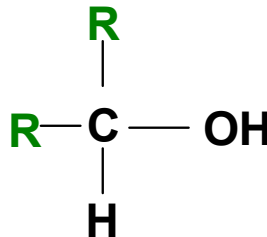
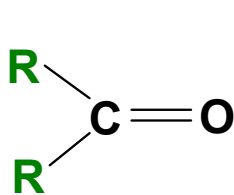
Ester



Aldehyd



Keton

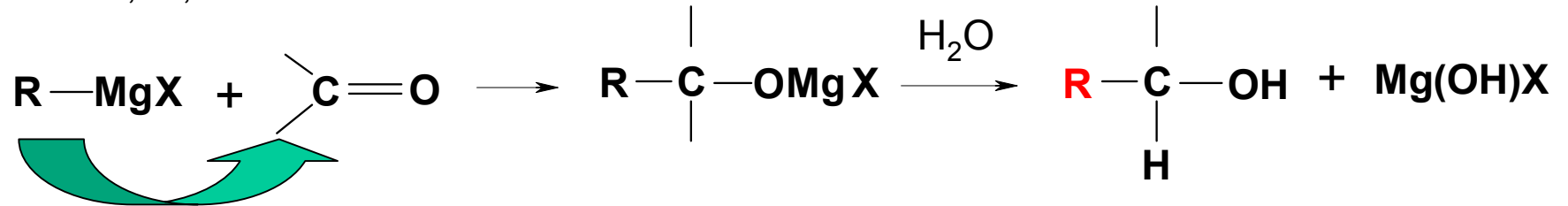


Sekundärer Alkohol

4. Grignardreaktion

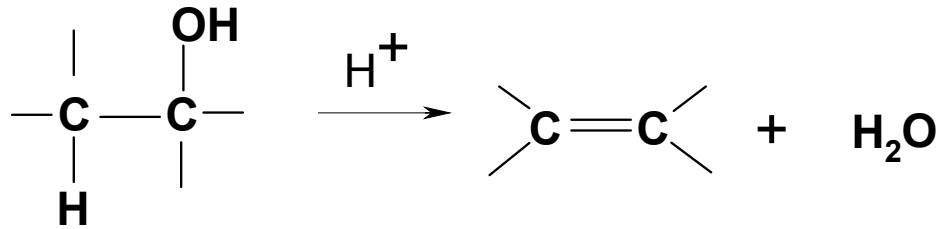


X = Cl, Br, I



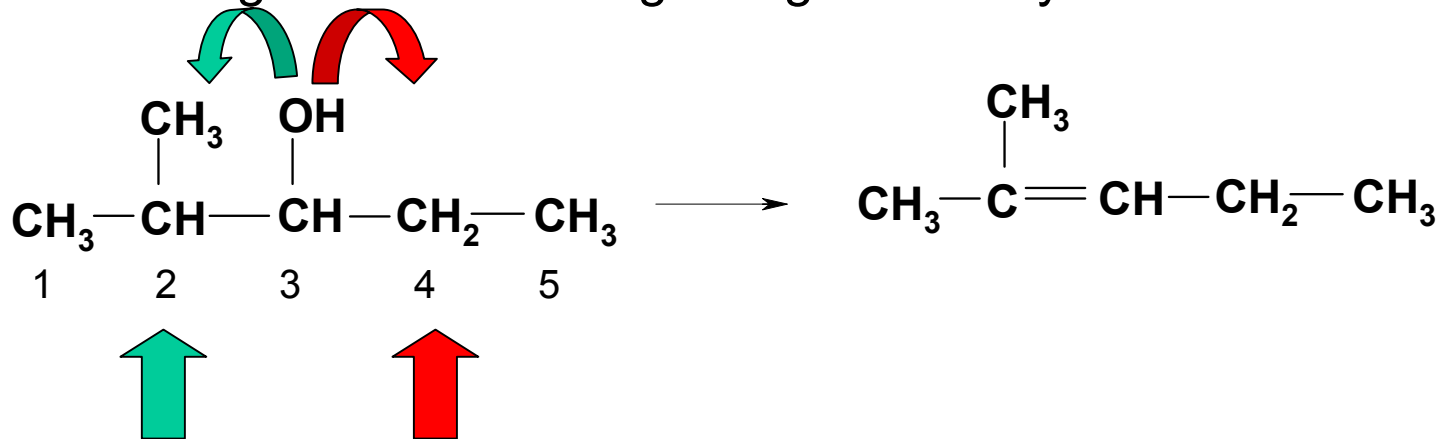
Reaktionen der Alkohole

1. Eliminierung zu Alkenen



Beispiel:
Ethen aus Ethanol
(170 °, H₂SO₄)

Richtung der Eliminierung - Regel von Saytzeff

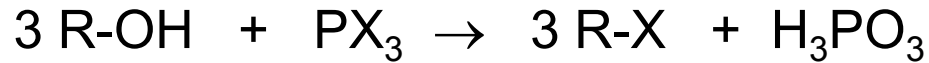


2-Methyl-3-pentanol

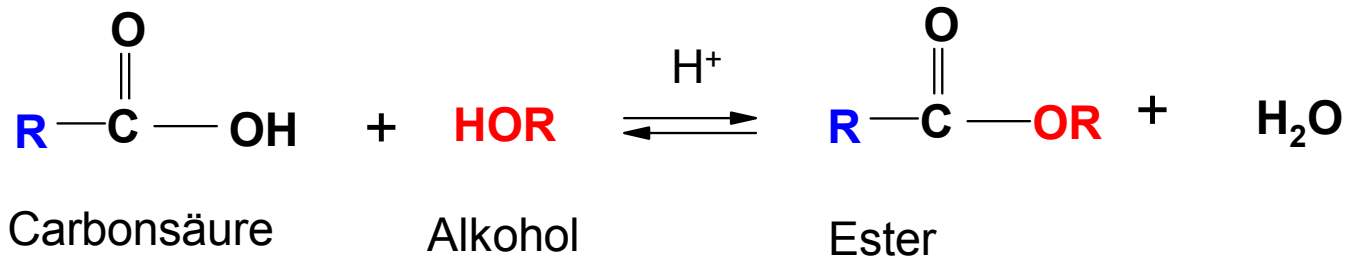
2-Methyl-2-penten

Reaktionen der Alkohole

2. Umsetzung zu Halogenalkanen

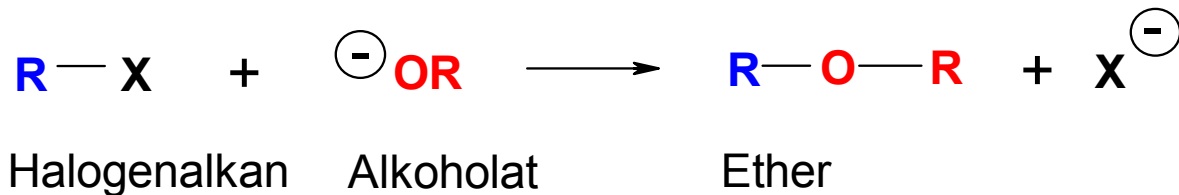


3. Esterbildung

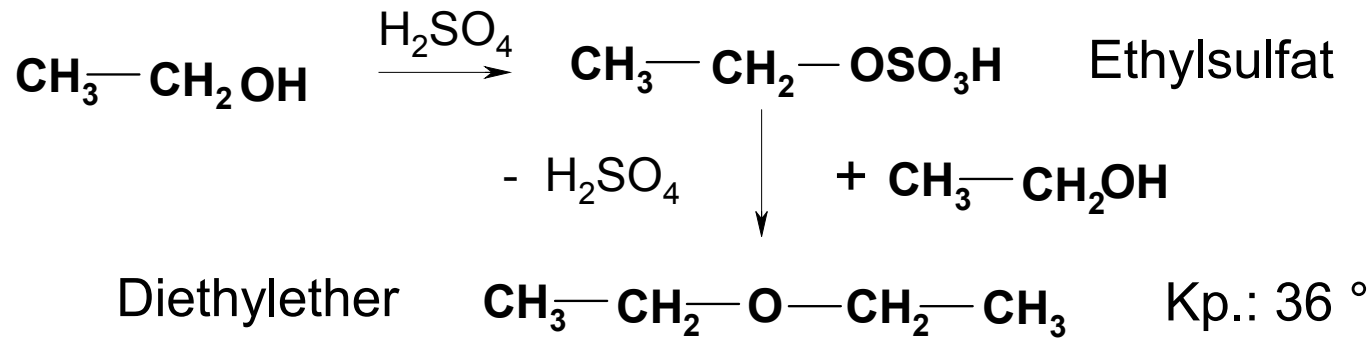


4. Etherbildung

Williamson-Synthese (S_N-Reaktion)

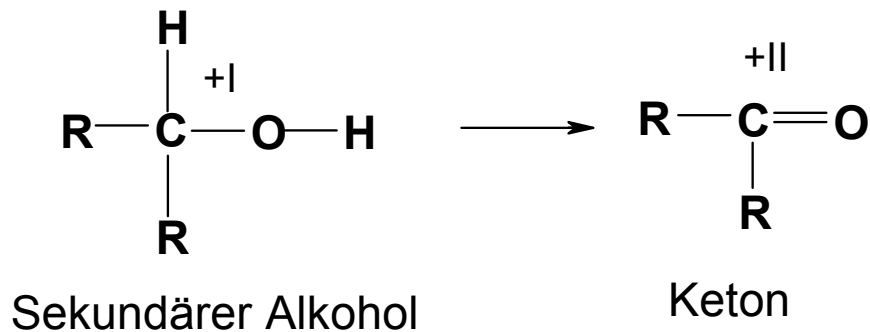
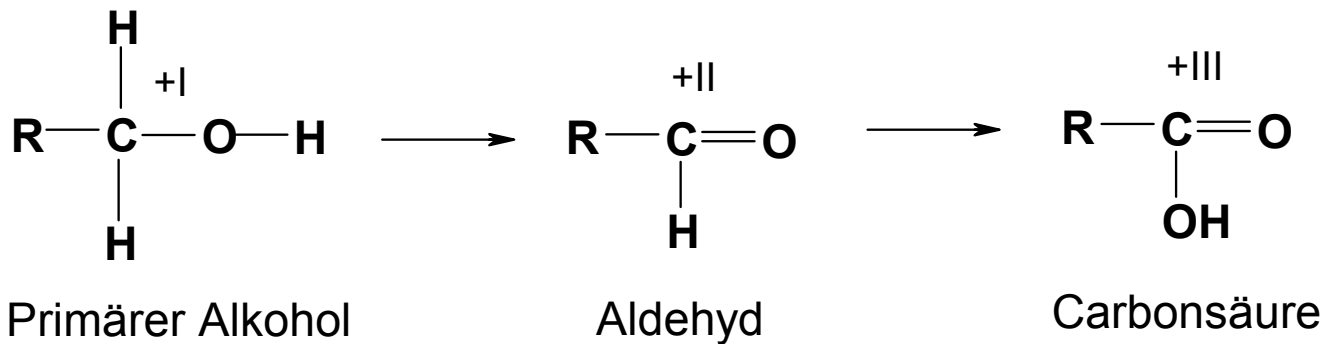


4. Etherbildung (Dehydratisierung)

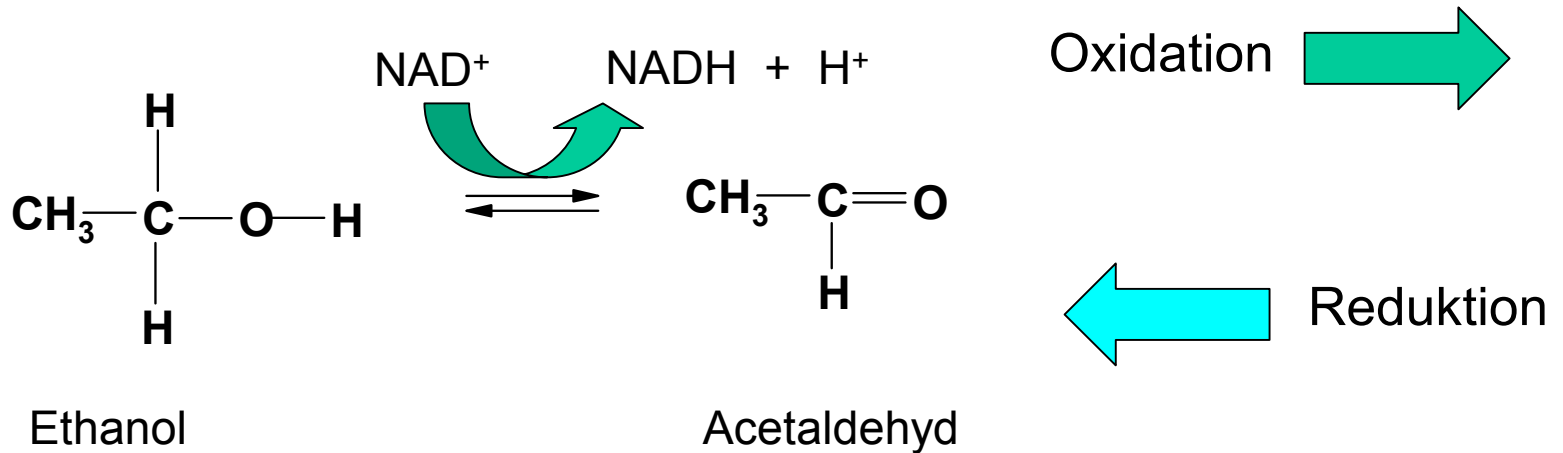


5. Oxidation (Dehydrierung)

Ox. Mittel: KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$, O_2/Pt



Biochemische Oxidation (Dehydrierung) von Ethanol



Enzym: **Alkohol**dehydrogenase (ADH)

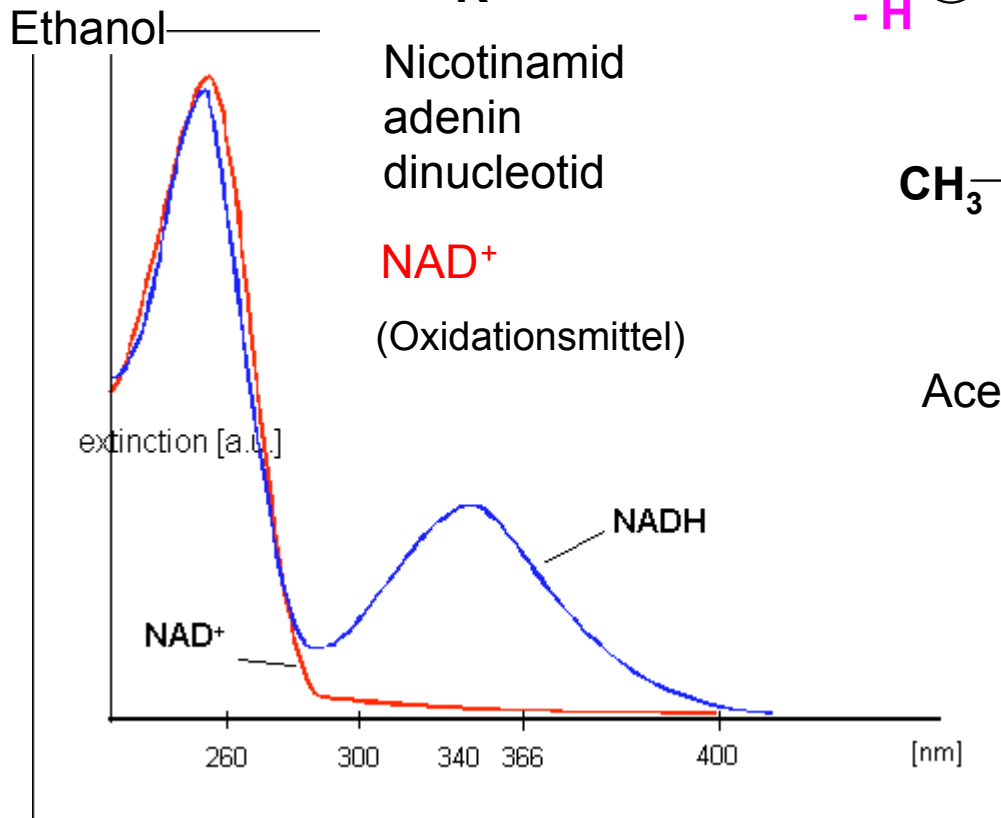
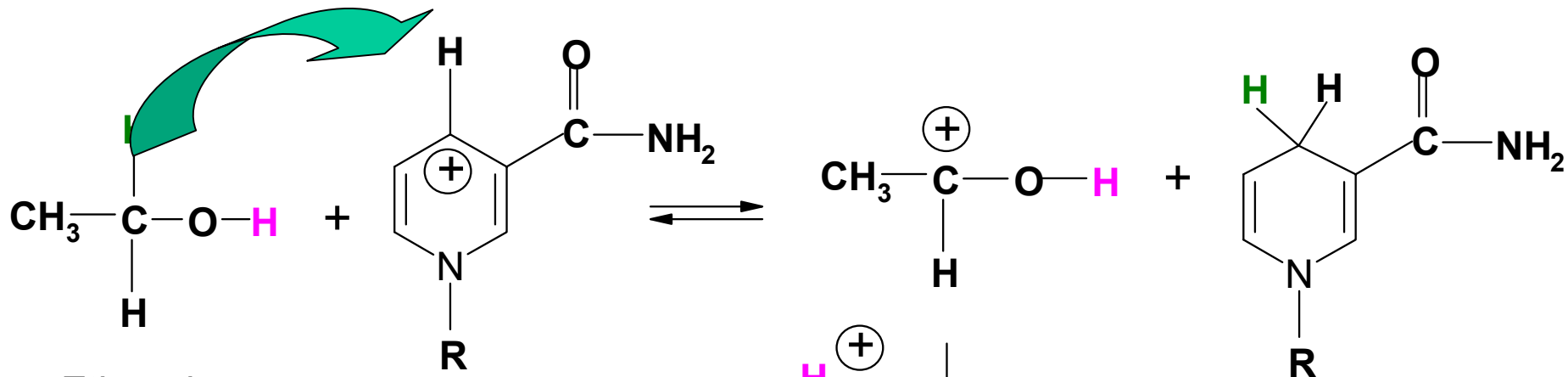
Nomenklatur

Substrat **Reaktion** -ase

Vorkommen: Hefe, Leber

benötigt Zn^{2+} und Coenzym NAD^+ (Vitamin B_2)

katalysiert beide Reaktionen: Oxidation und Reduktion



Maximum bei 340 nm

ADH-Reaktion

Bildung von Ethanol bei der alkoholischen Gärung (Reduktion)

Entgiftung von Ethanol in der Leber (Oxidation)

Enzymatische Bestimmung von Ethanol

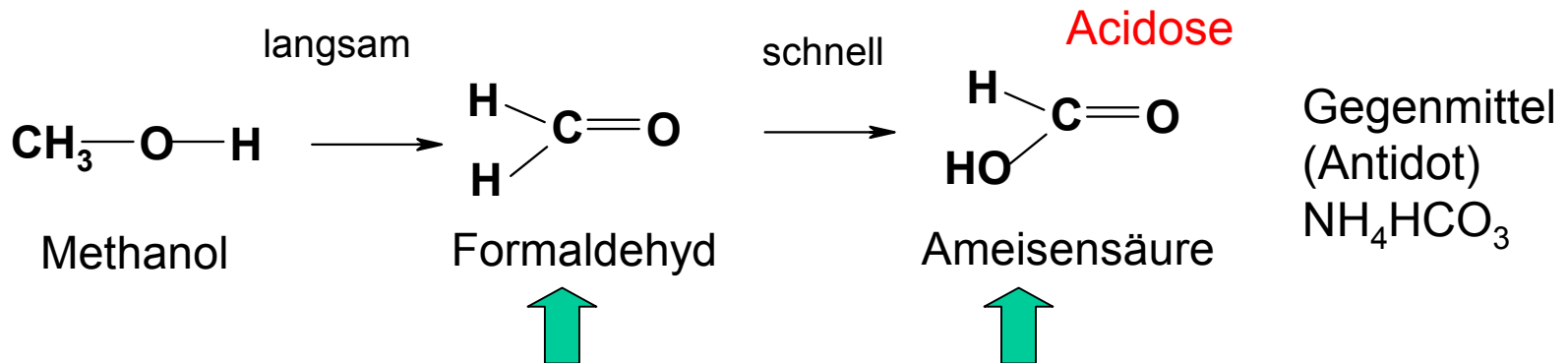
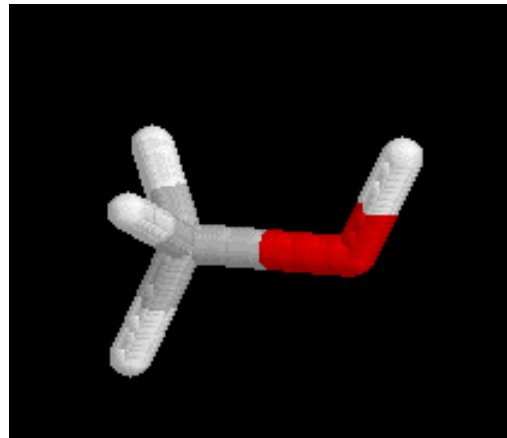
(photometrische Messung von NADH)

Einwertige Alkohole

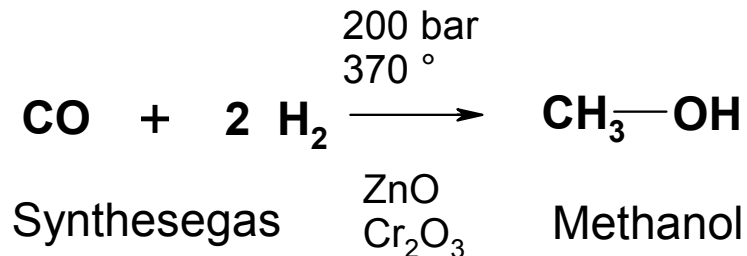
Methanol CH_3OH

Kp.: 64.7°

(Methylalkohol, Holzgeist)



Herstellung



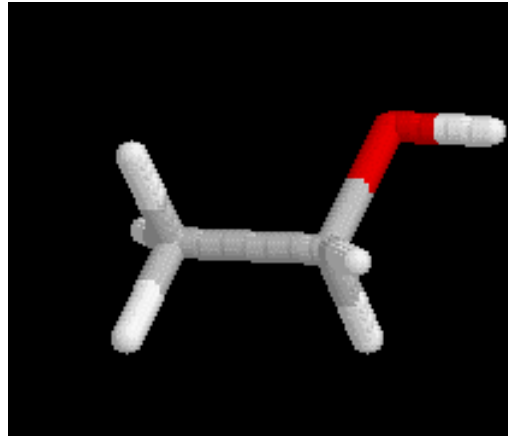
Giftig, Erblindung, letale Dosis: $\sim 25 \text{ g}$

Einwertige Alkohole

Ethanol $\text{CH}_3\text{CH}_2\text{OH}$

Kp.: $78,3^\circ$

(Ethylalkohol)



Mischungen mit Wasser sind durch Destillation nicht vollständig trennbar:

Azeotrop mit Siedepunktminimum ($78,2^\circ$) bei 95,6% Ethanol

Herstellung von wasserfreiem (absolutem) Alkohol:

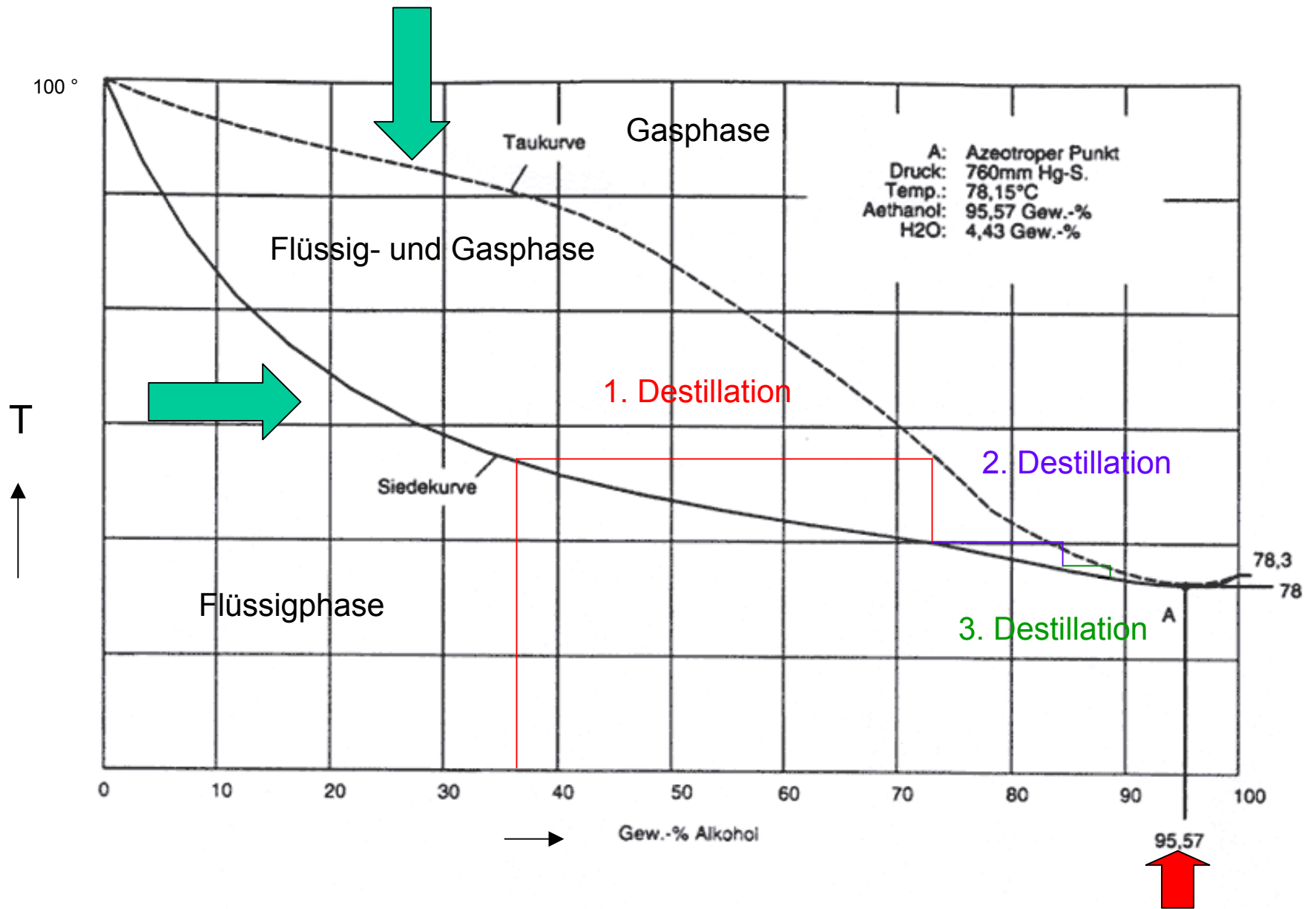
Trocknung mit Molekularsieben

oder azeotrope Destillation mit Benzol

Benzol-Alkohol-Wasser

Benzol-Alkohol

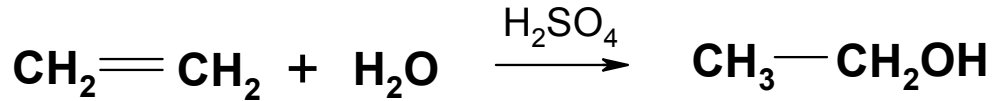
Alkohol



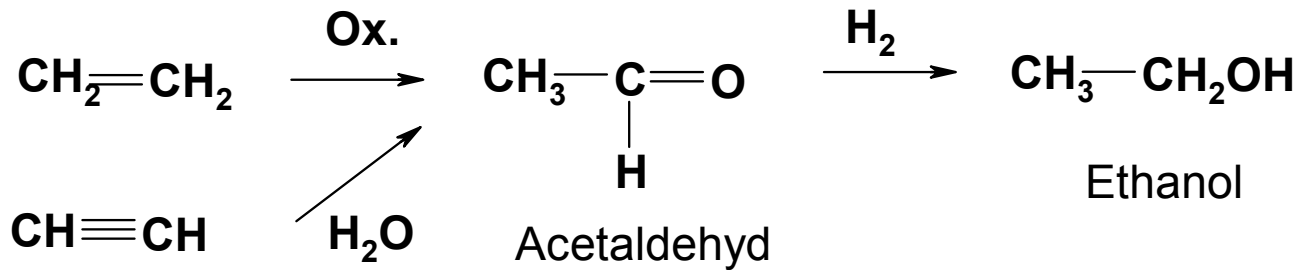
Siede- und Taukurve für das Flüssigkeitsgemisch Ethylalkohol-Wasser mit Minimumspunkt

1. Hydratisierung von Ethen

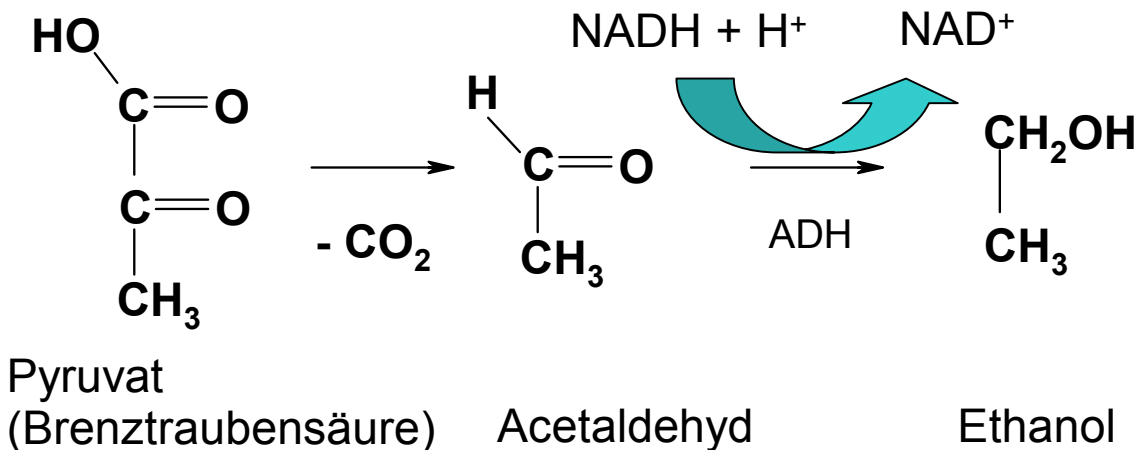
Herstellung von Ethanol



2. Reduktion von Acetaldehyd



3. Alkoholische Gärung (*Saccharomyces cerevisiae*), anaerob



Toxikologische Eigenschaften

in 70%iger Lösung bakterizid

Resorption: 20% Magen

80% Darm

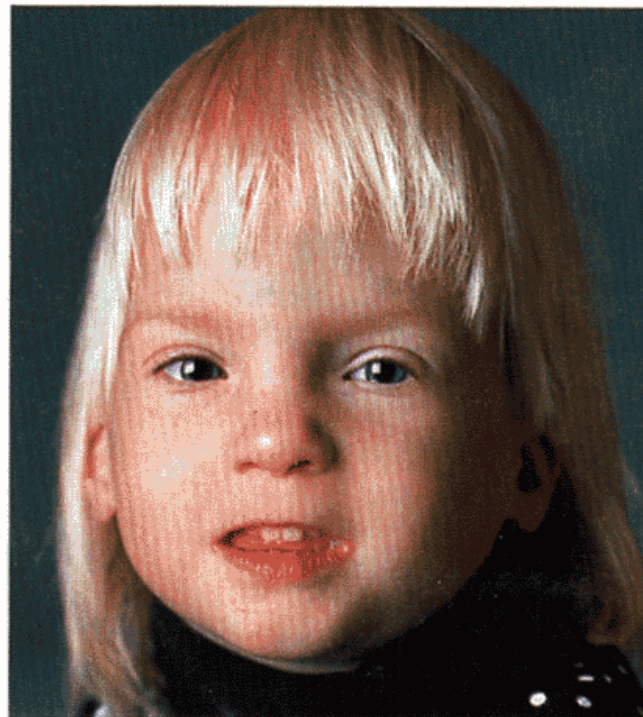
Direkt: narkotische Wirkung auf ZNS

Chronischer Alkoholabusus: Fettleber, Zirrhose
(Oxidation von EtOH in der Leber)

Teratogen: Fetales-Alkohol-Syndrom, FAS

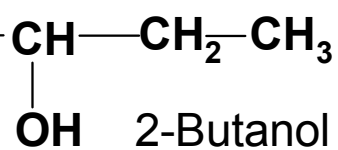
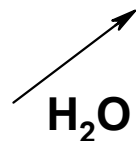
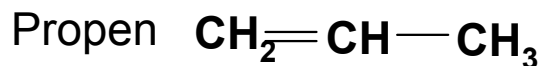
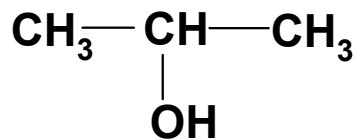
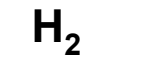
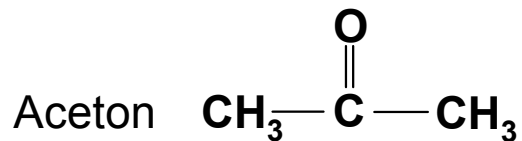


SIX-YEAR-OLD BOY; SEATTLE

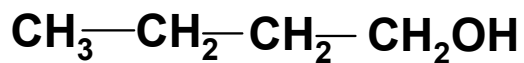


THREE-YEAR-OLD GIRL; SWEDEN

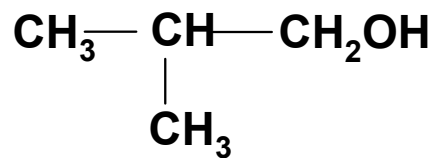
Weitere Alkohole



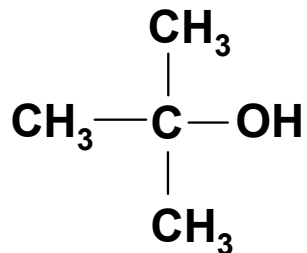
2-Butanol



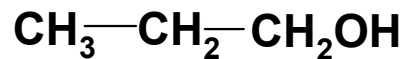
1-Butanol



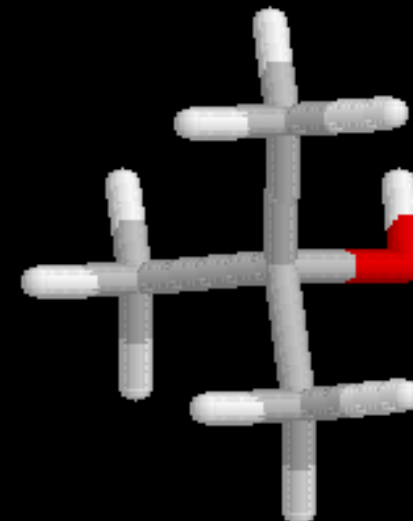
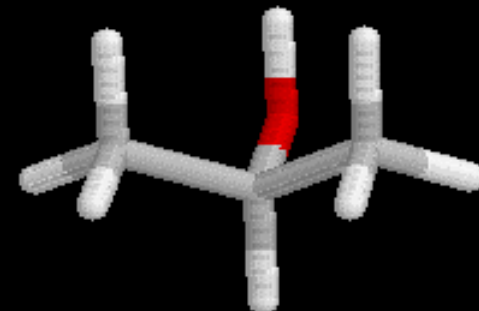
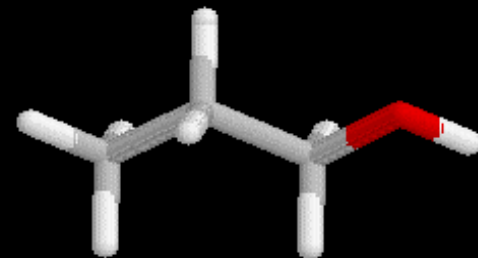
2-Methyl-1-propanol



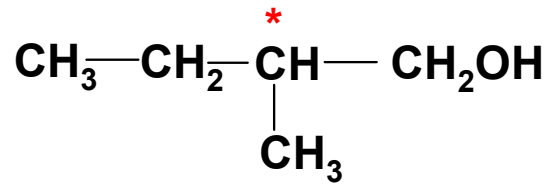
tert-Butanol



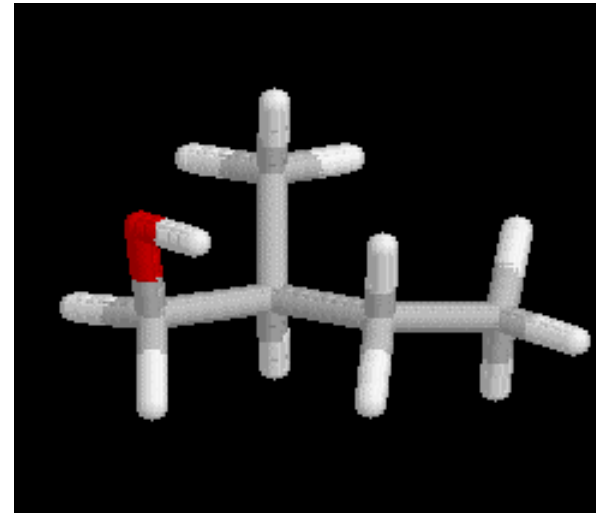
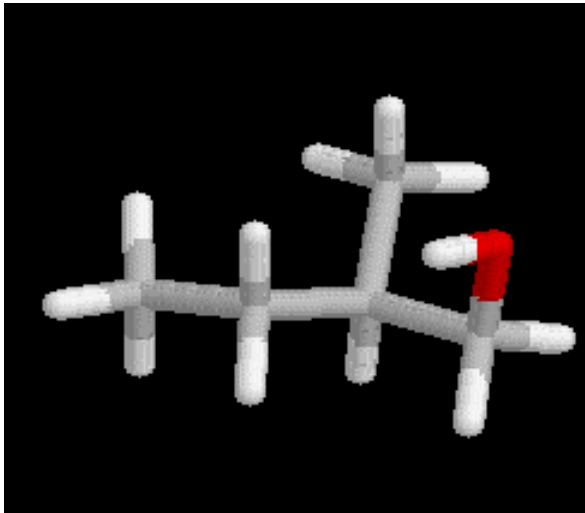
1-Propanol



8 isomere Pentanole (Amylalkohole)



optisch aktiver Amylalkohol



Optische Isomerie
„Spiegelbildisomerie“