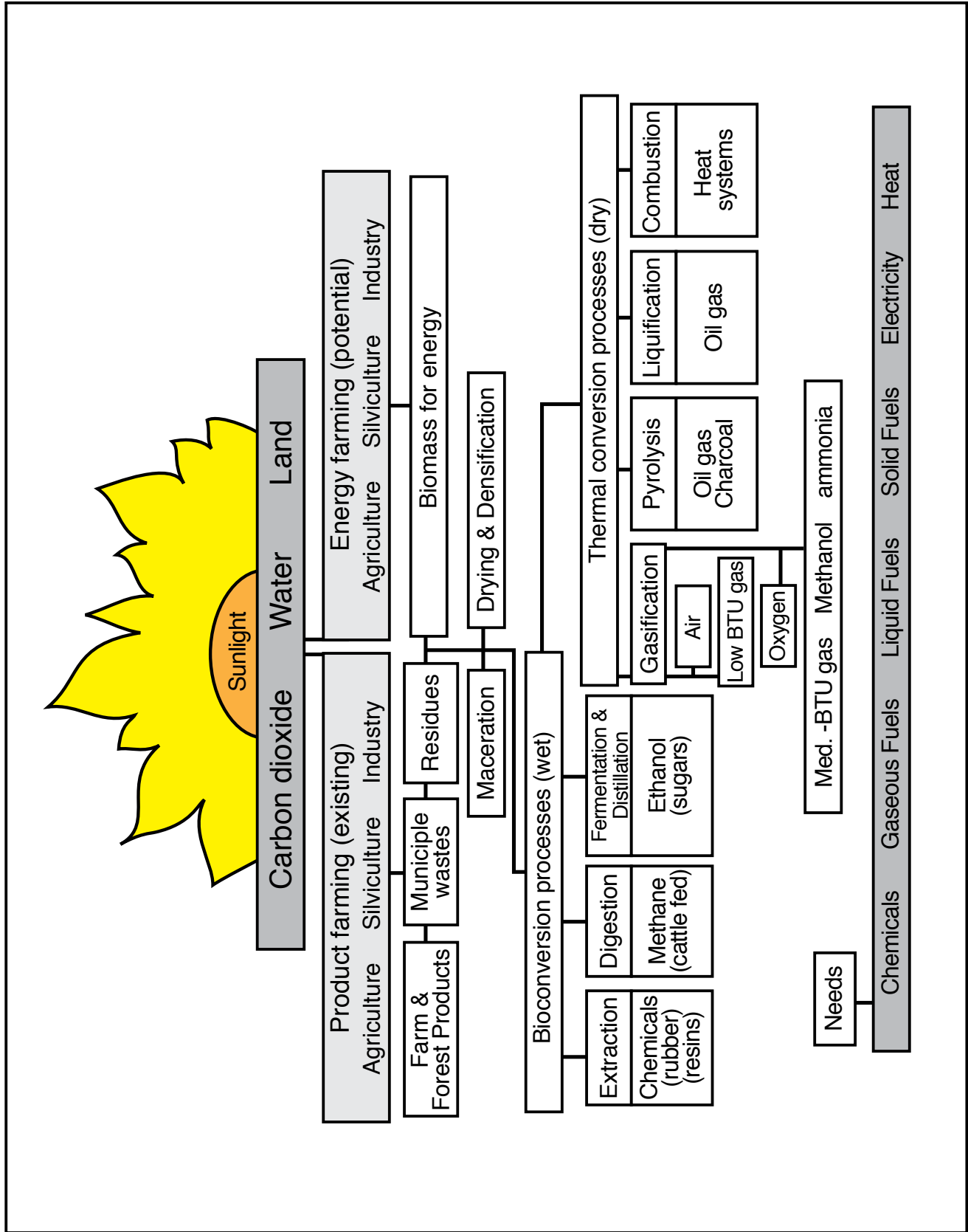


ALL POWER LABS
GASIFIER EXPERIMENTERS KIT

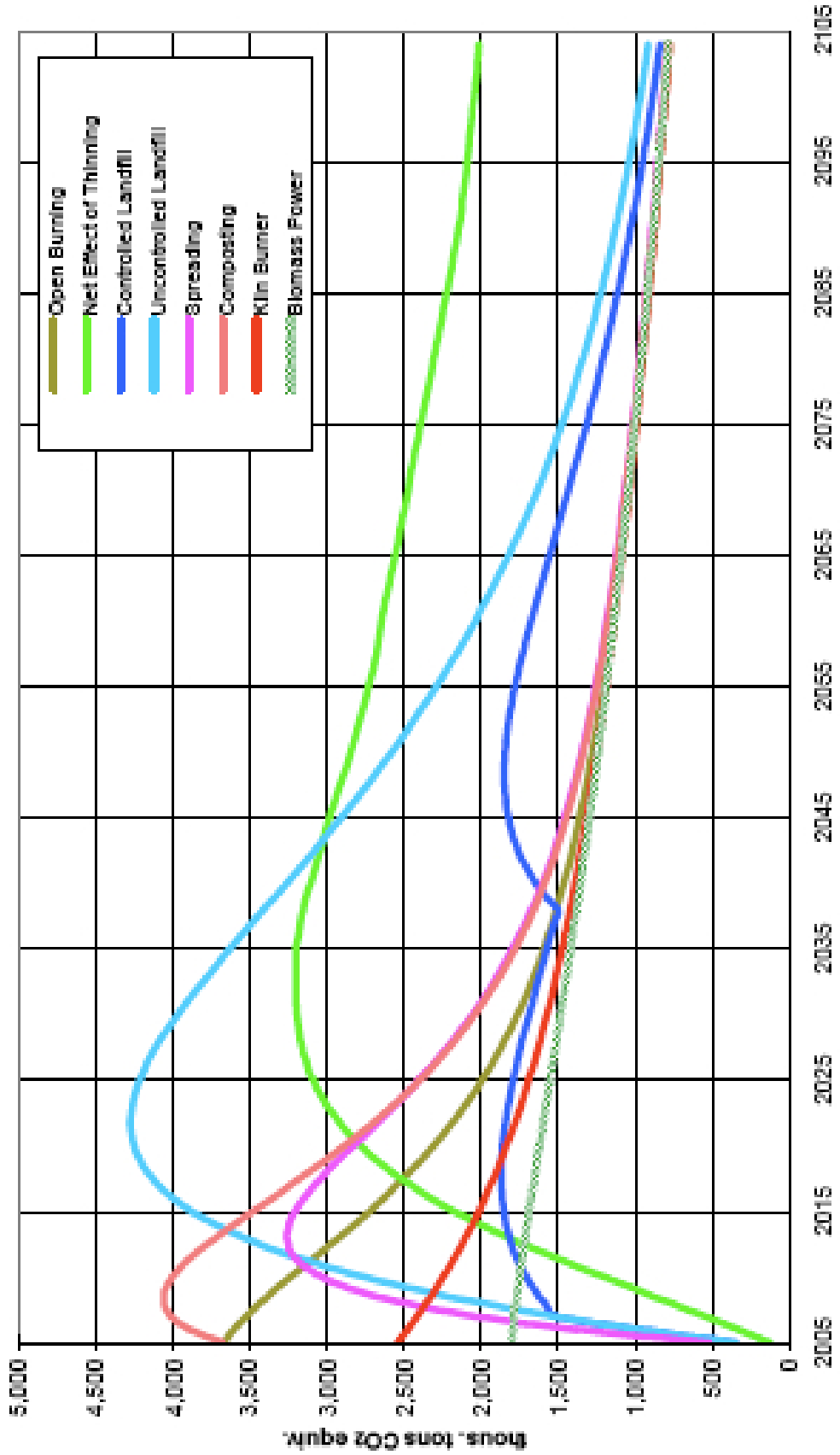
Gasification Basics

Pathways of Biomass Energy

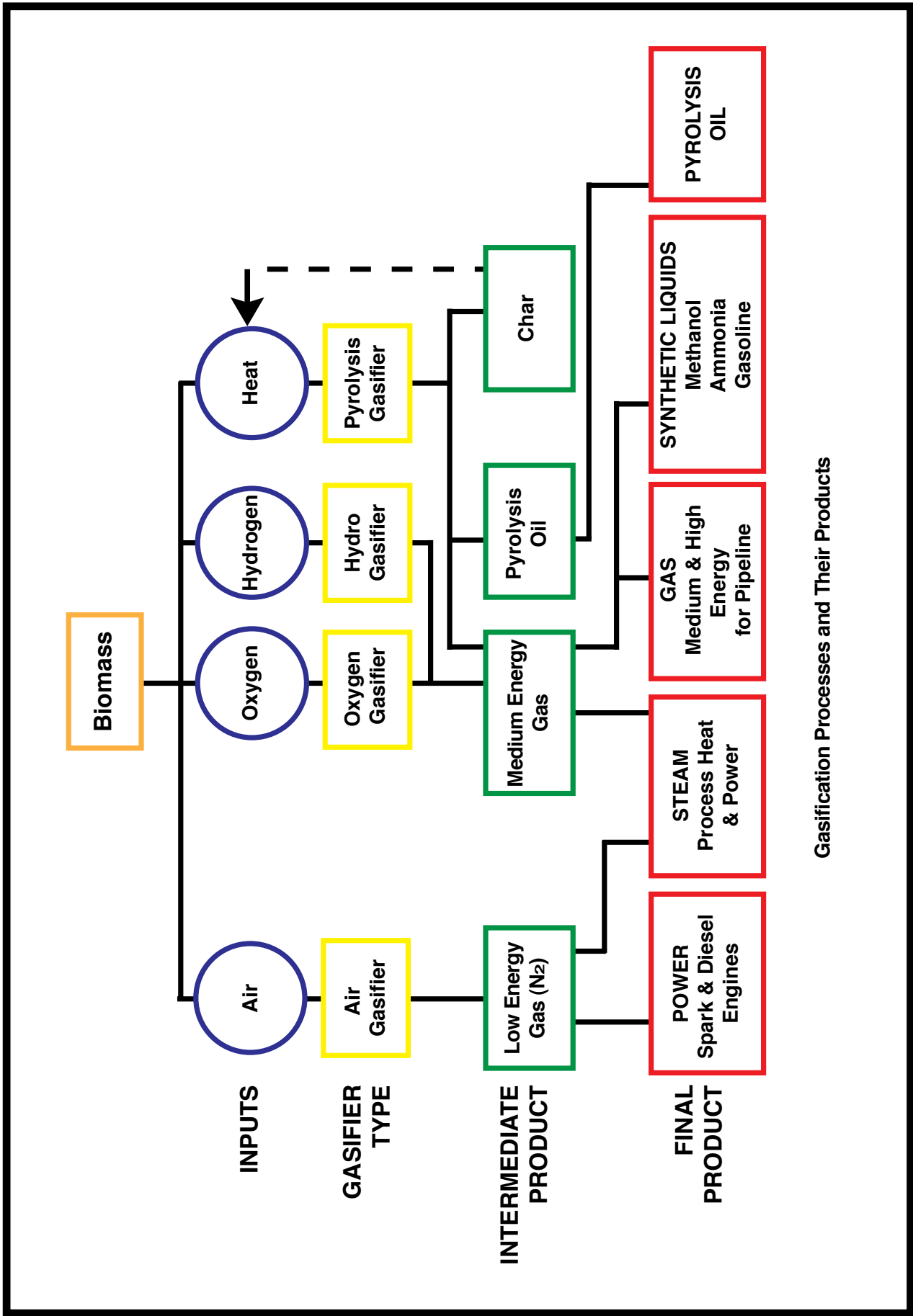


Source: Tom Reed 1978

GHG Burden associated with the Disposal of 1 million bdt of Biomass

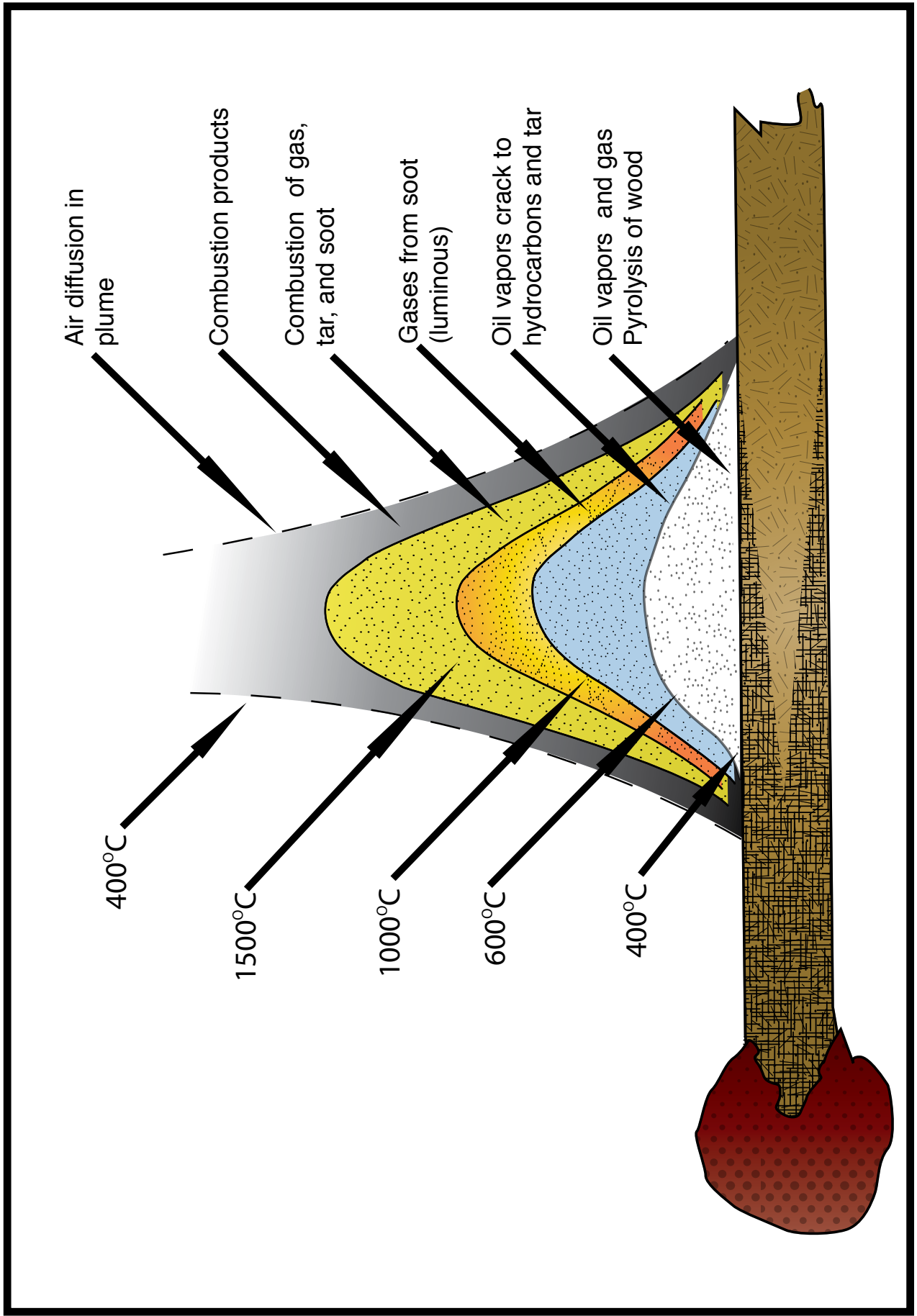


Pathways of Biomass Thermal Conversion



Adapted from Tom Reed

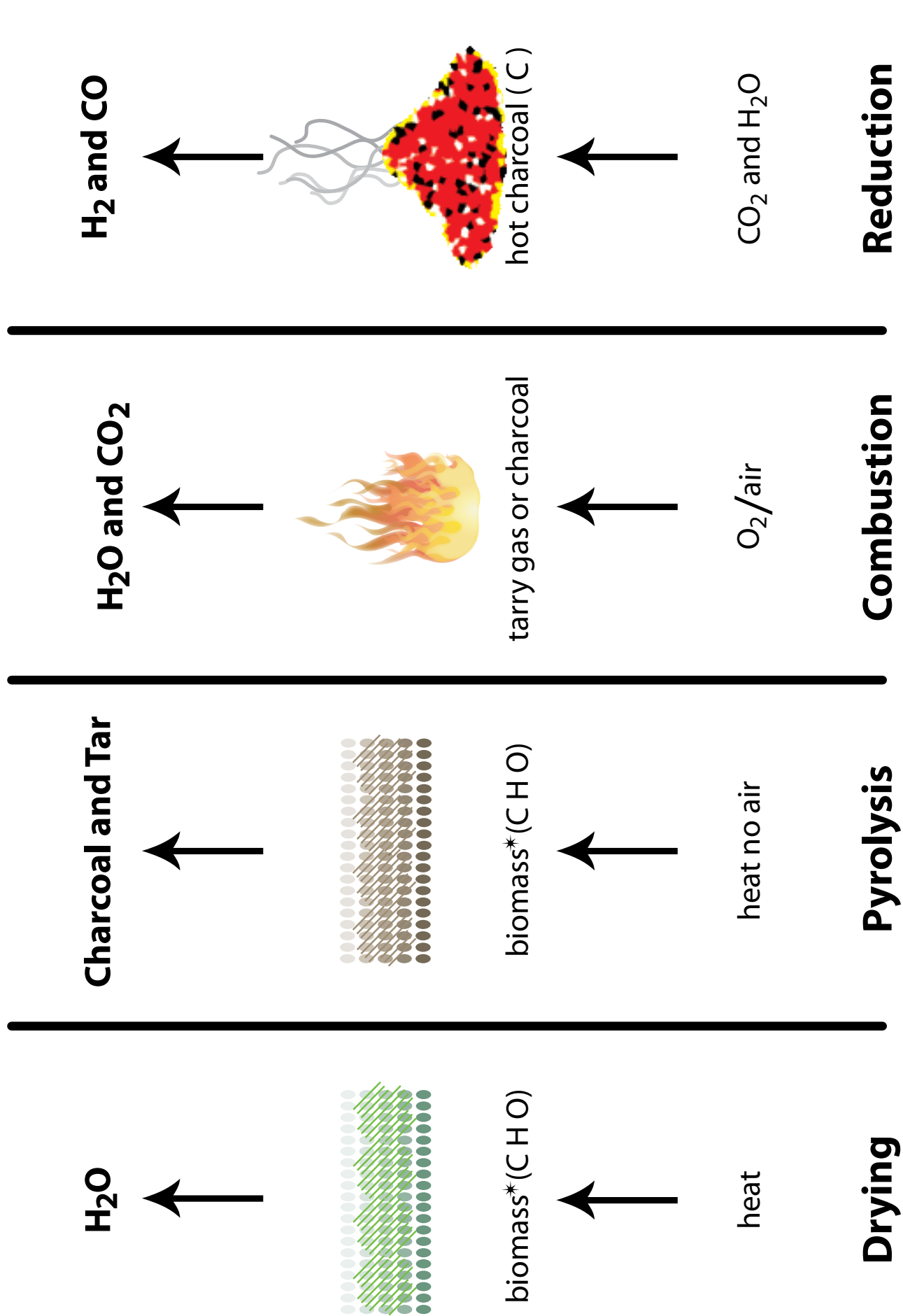
Pyrolysis, Gasification and Combustion in a Flaming Match



Adapted from Tom Reed

4 Processes in Gasification

not necessarily in order



* Biomass is a combination of C, H, and O (C H_{1.4} O_{0.6})

Temperature and Yield Profile for Biomass Pyrolysis

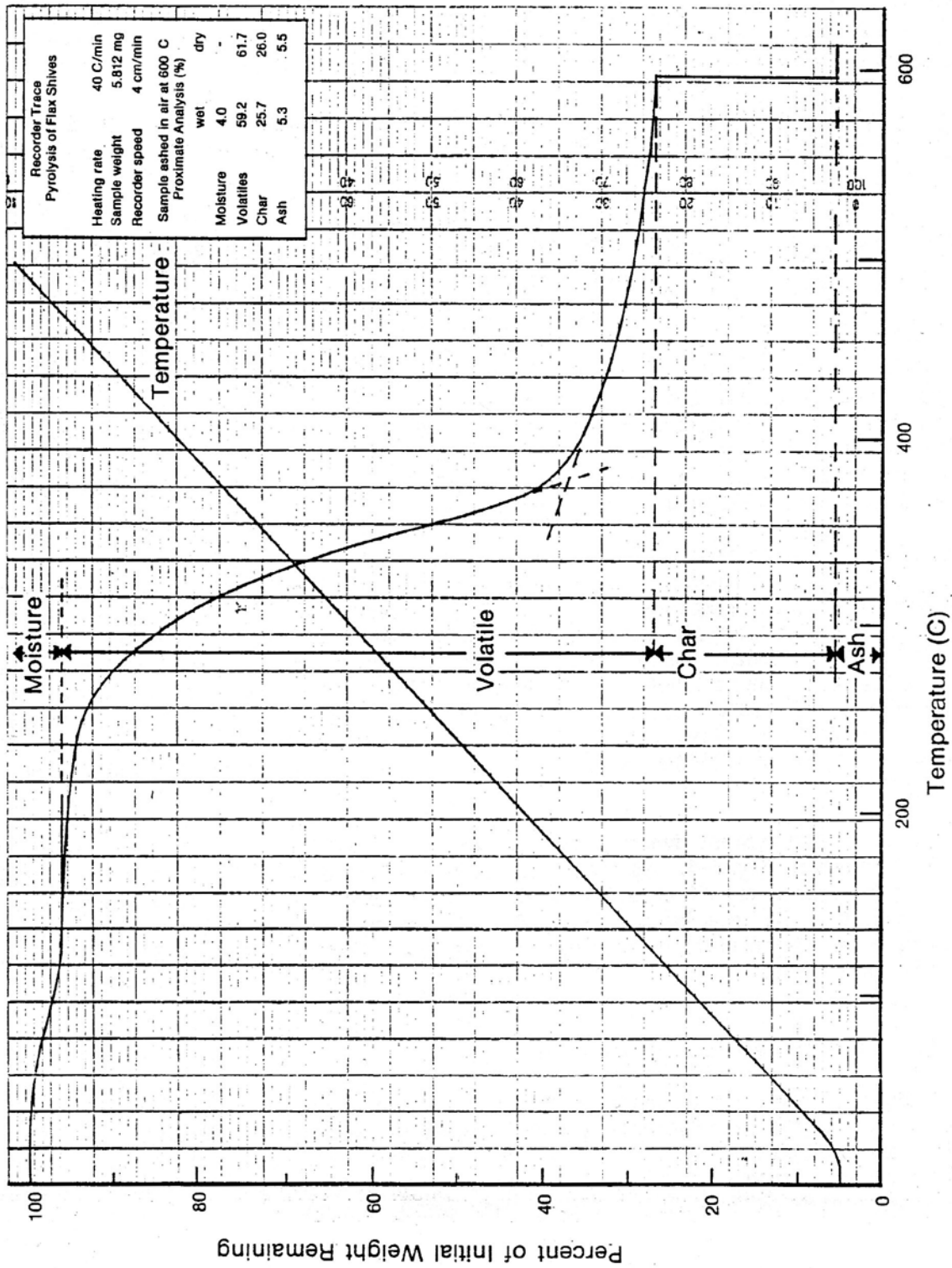
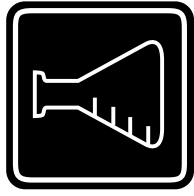


Figure 5-2. A Typical Dynamic TGA Result Obtained with Flax Shives and Showing Moisture, Volatile Matter, Char, and Ash Content

Source: T. Milne 1979



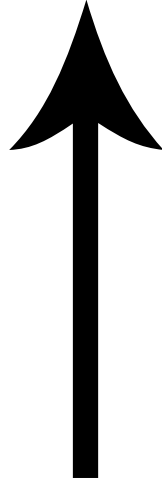
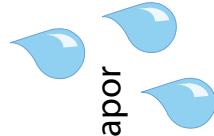
The Reduction Reactions

The Heart of Gasification

INPUT



carbon dioxide + water vapor



C
carbon

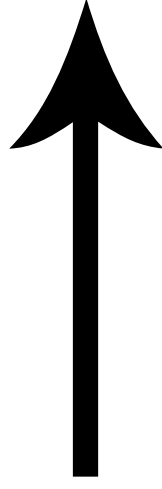


Red Hot Charcoal Bed

OUTPUT



hydrogen + carbon monoxide



REACTIONS



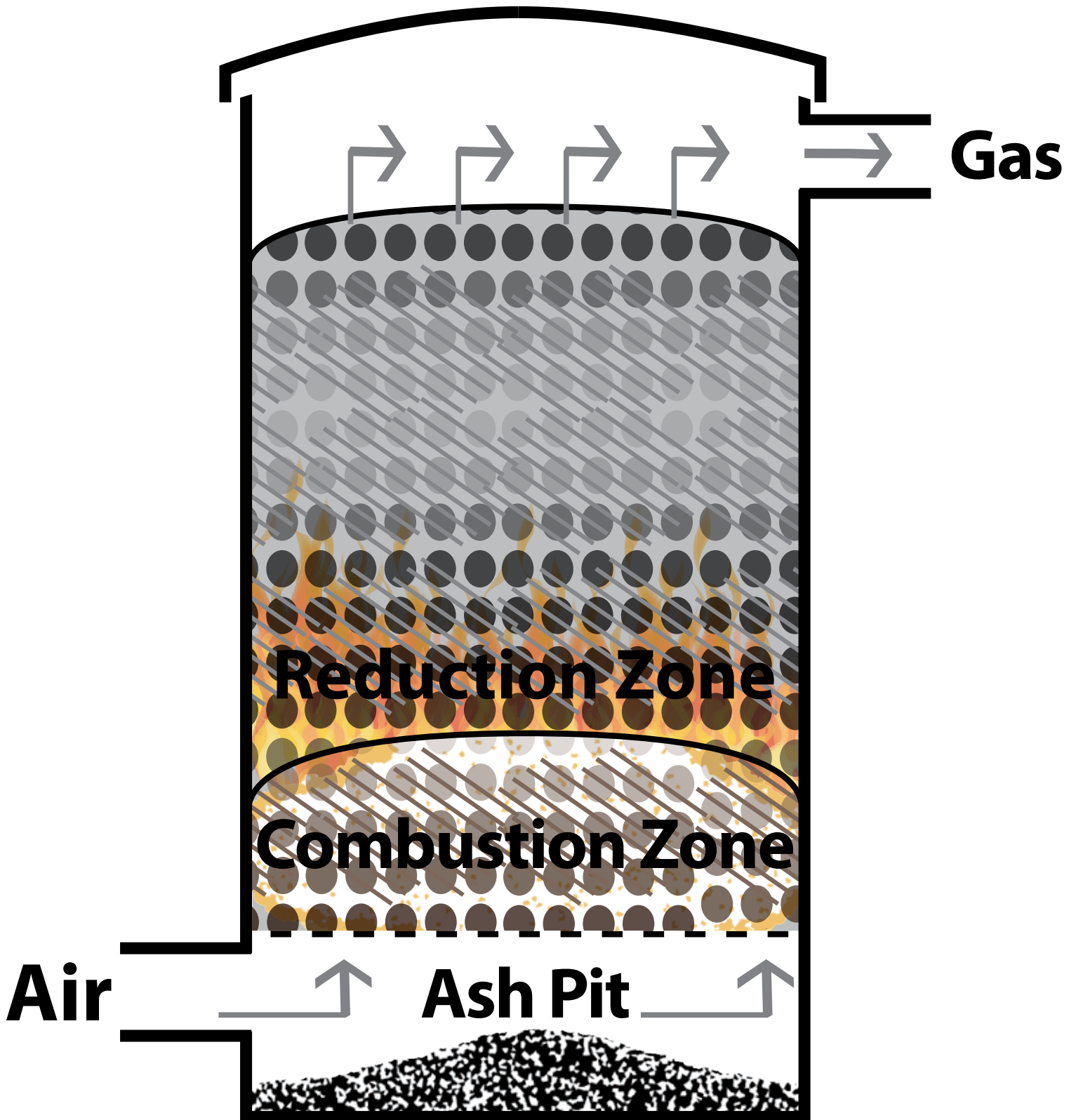
carbon dioxide + carbon = carbon monoxide



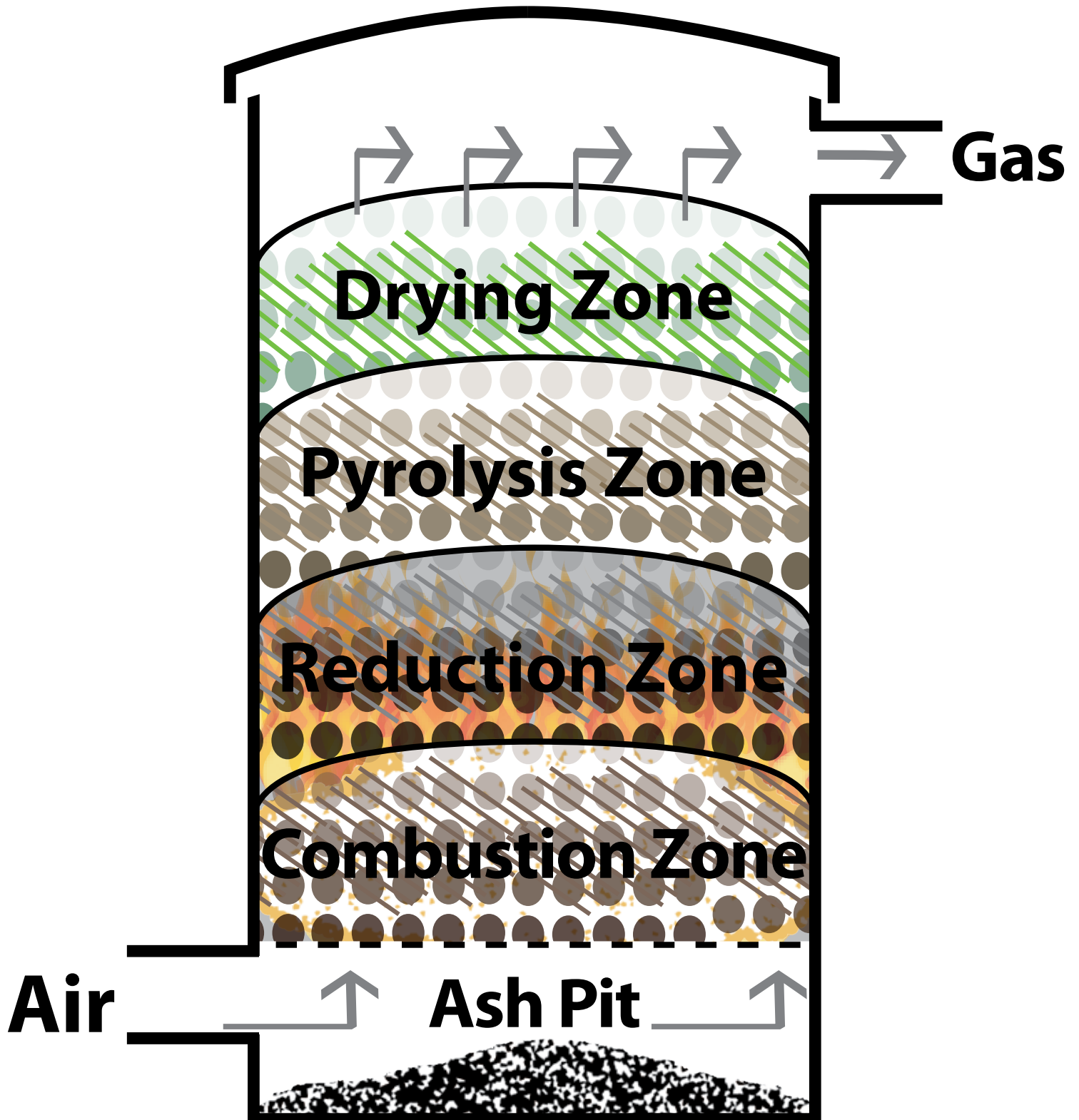
water vapor + carbon = hydrogen + carbon monoxide

Updraft Gasifier

Charcoal Only

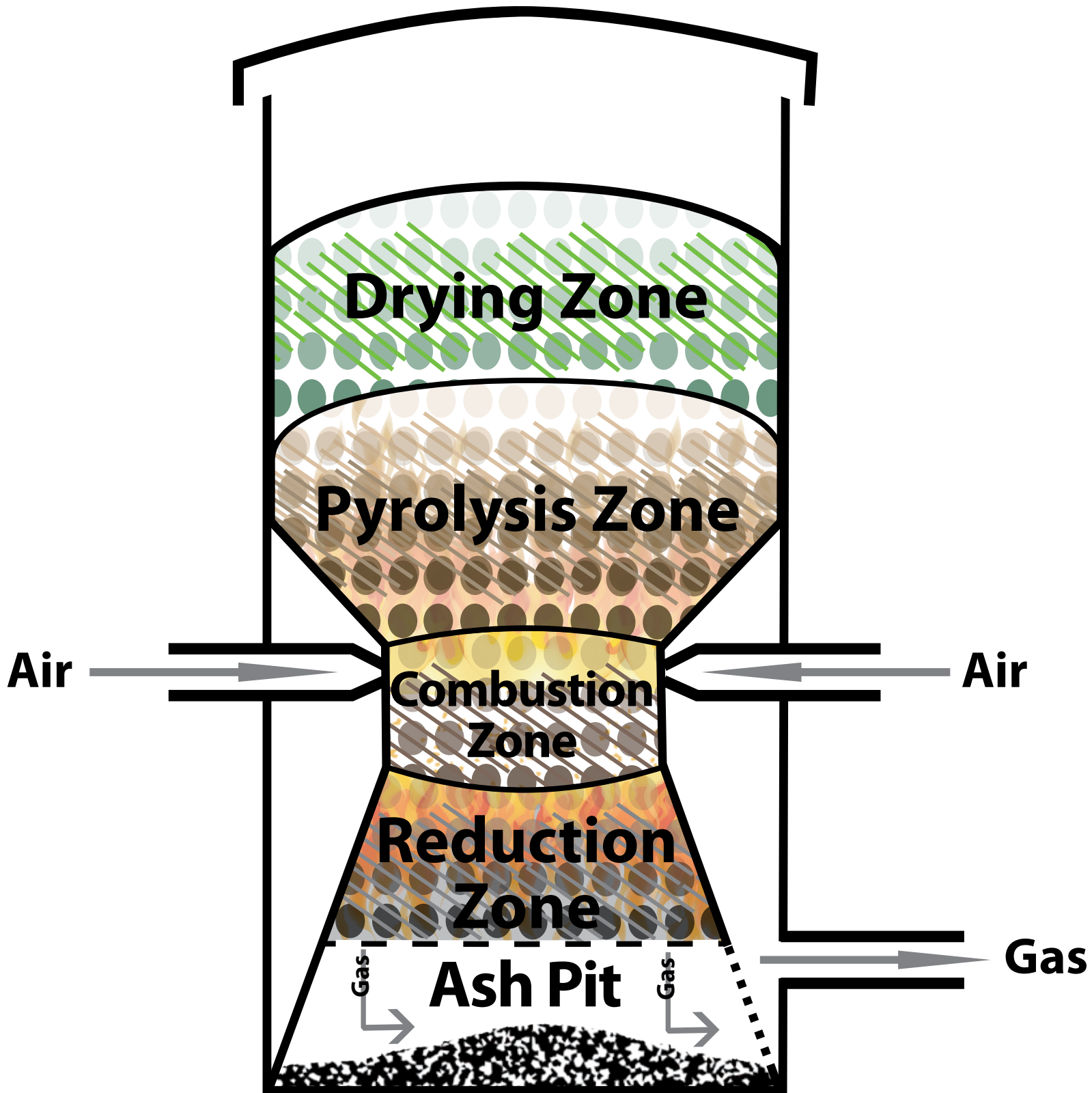


Updraft Gasifier

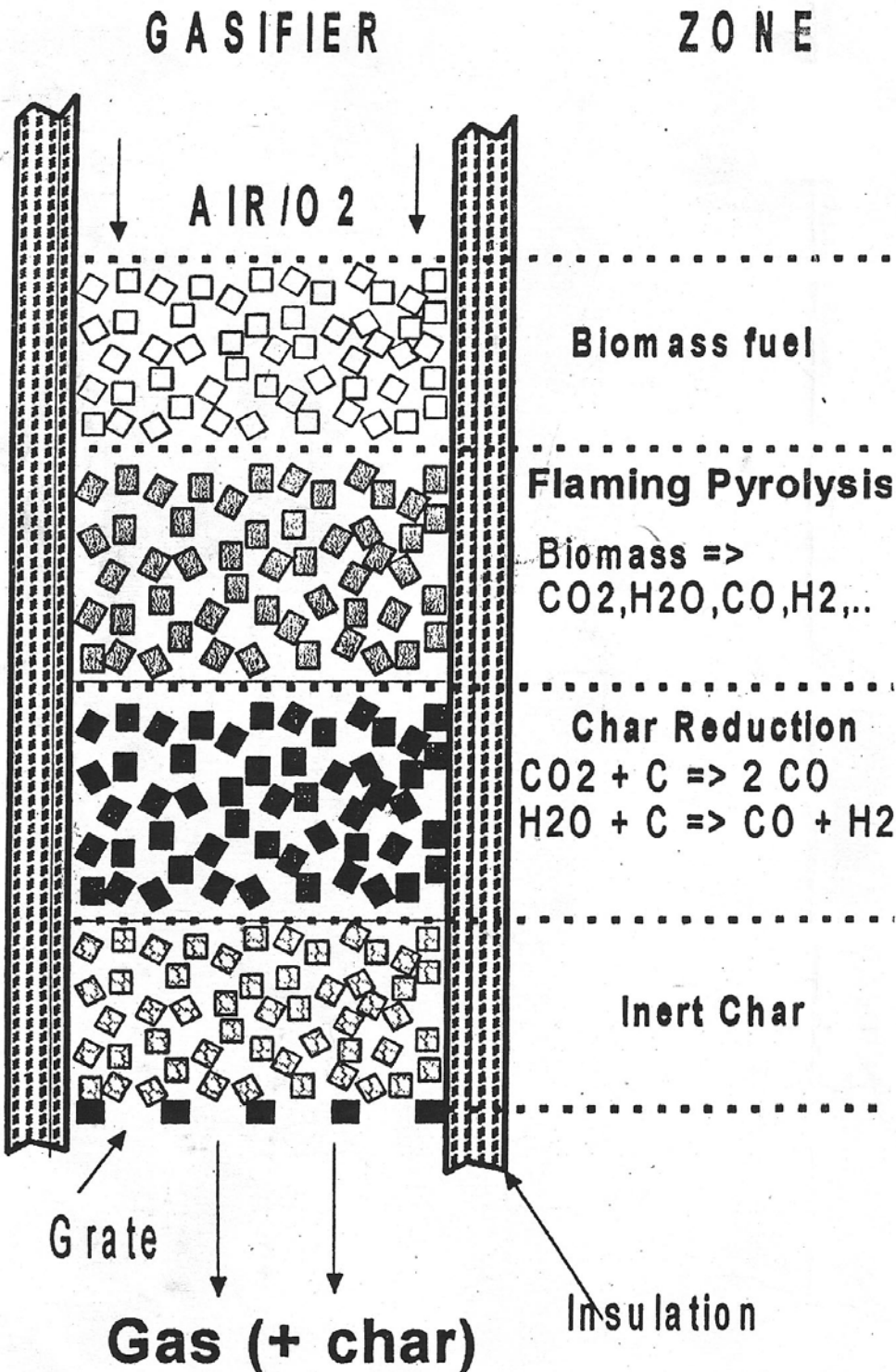


Downdraft Gasifier

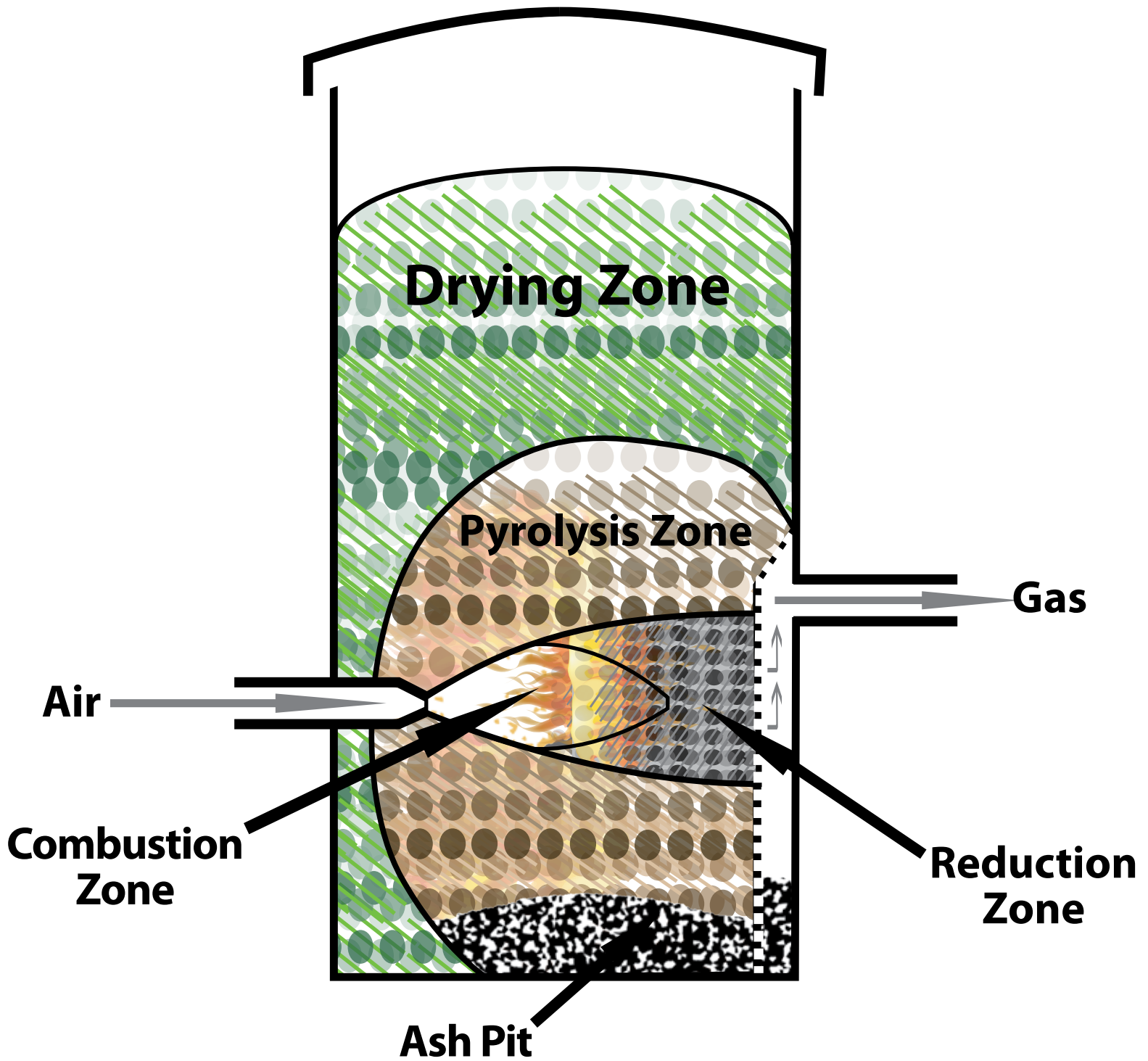
Nozzle and constriction (Imbert)



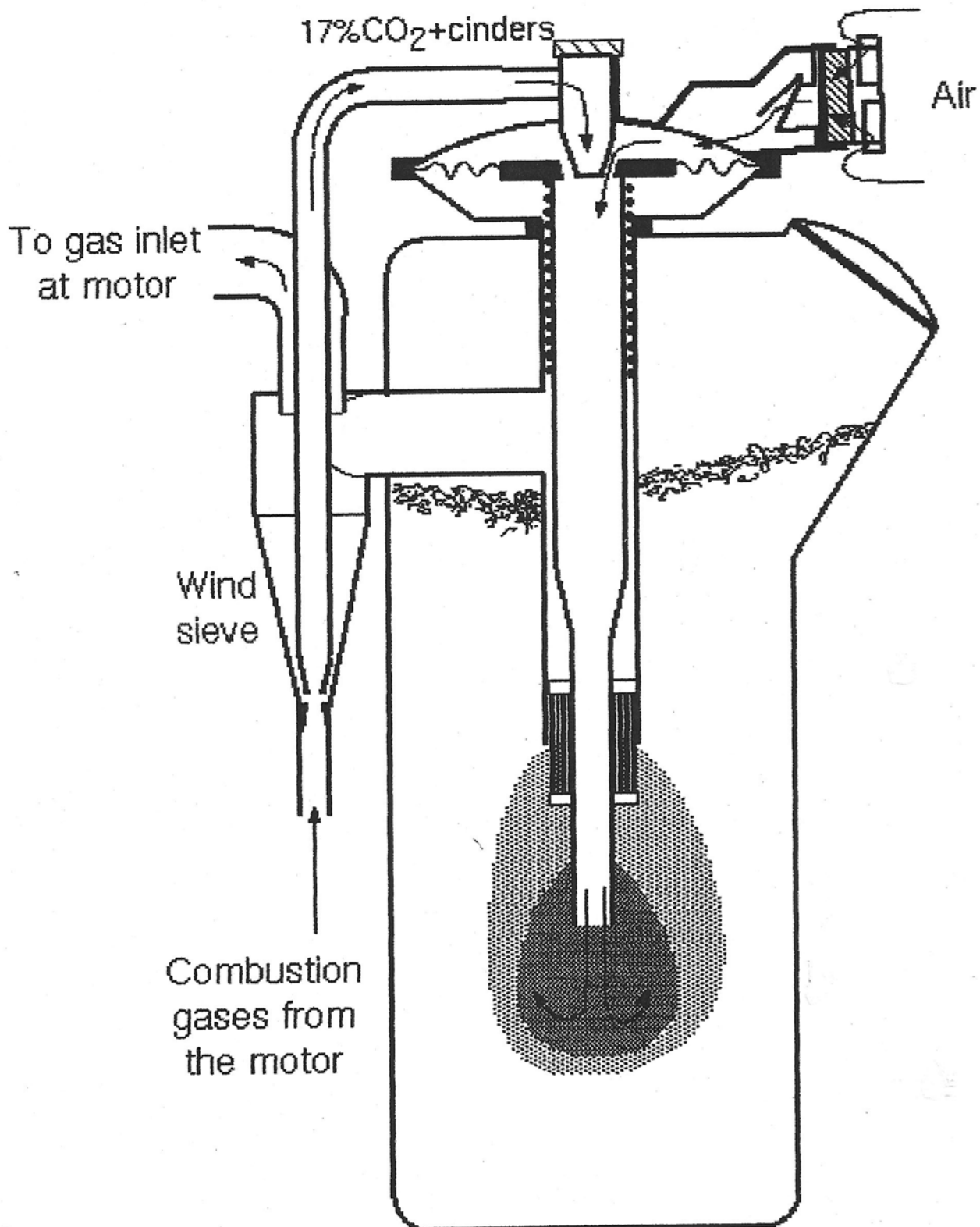
Stratified Downdraft / Open Core



Crossdraft Gasifier

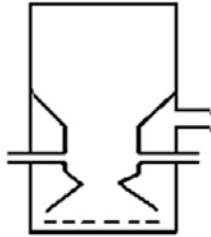


The Kalle Gasifier

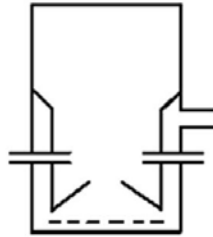


Downdraft Gasifier Types

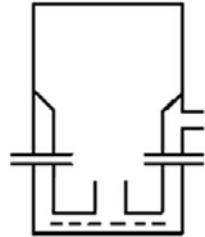
Nozzle and Constriction Closed Top Designs (aka: Imbert type)



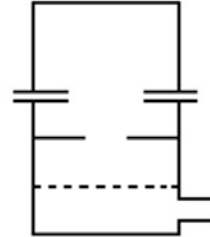
Imbert Hourglass
(double throat)



Inverted V Hearth
(Sweedish origin)

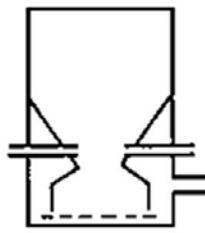


Straight Reduction Tube

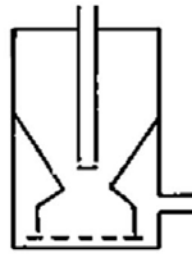


Constriction Plate

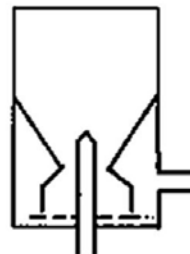
Air Inlet Variations (shown with Imbert Hourglass single throat type)



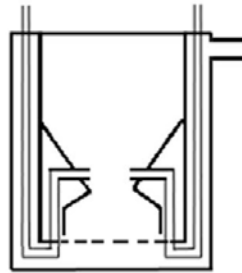
Side Inlets



Central Inlet
(down from top)



Central Inlet
(up from bottom)

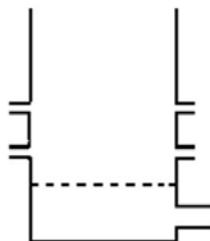


J tube
(air preheating)

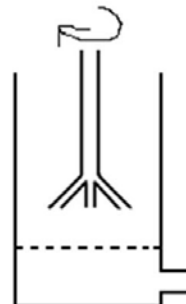
Open Core Designs



Stratified Downdraft
(Tom Reed, FEMA)



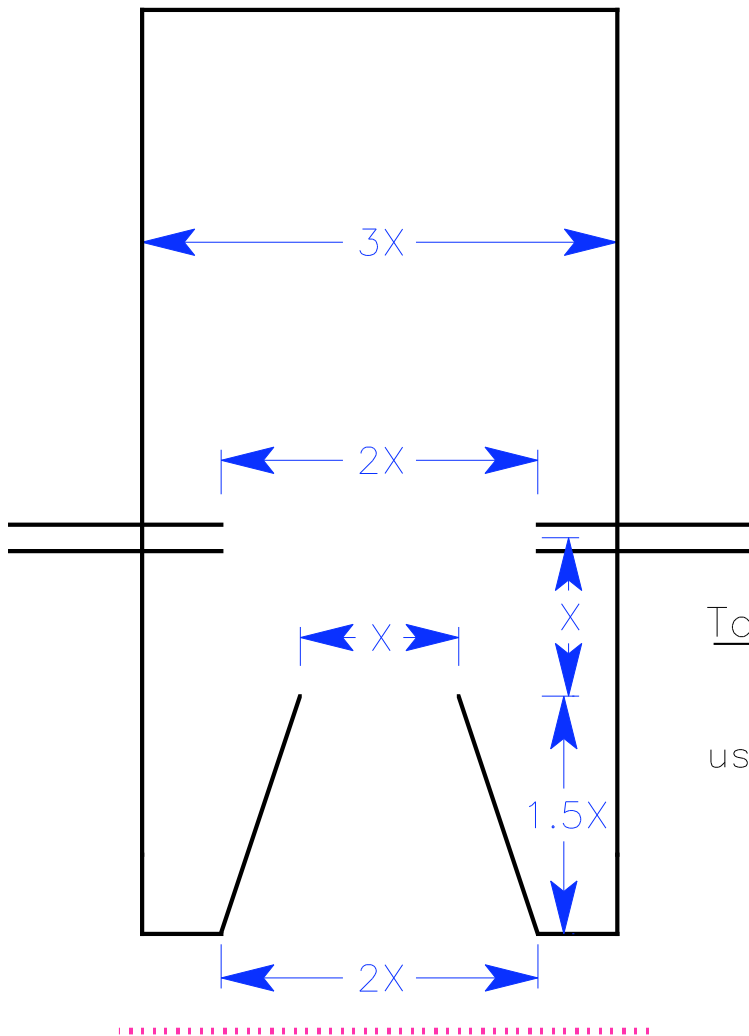
Multi-point Air Injection
(Mukunda, CPC)



Buck Rogers

General Proportions for Inverted V Hearth Downdraft Gasifier

(see charts for more detailed dimensions and variations)



$$\frac{\text{Total area of nozzles}}{(X)} = .05$$

use odd number of nozzles

ALL Power Labs June 16, 2008

Table 5-2. Imbert Nozzle and Hearth Diameters

d_i/d_h	d_h mm	d_r mm	d_r' mm	h mm	H mm	R mm	A No.	d_m mm	$\frac{A_m \times 100}{A_h}$	$\frac{d_r}{d_h}$	$\frac{h}{d_h}$	Range of Gas Output		Maximum Wood Consumption kg/h	Air Blast Velocity Vm m/s
												max. Nm ³ /h	min. Nm ³ /h		
268/60	60	268	150	80	256	100	5	7.5	7.8	4.5	1.33	30	4	14	22.4
268/80	80	268	176	95	256	100	5	9.0	6.4	3.3	1.19	44	5	21	23.0
268/100	100	268	202	100	256	100	5	10.5	5.5	2.7	1.00	63	8	30	24.2
268/120	120	268	216	110	256	100	5	12.0	5.0	2.2	0.92	90	12	42	26.0
300/100	100	300	208	100	275	115	5	10.5	5.5	3.0	1.00	77	10	36	29.4
300/115	115	300	228	105	275	115	5	11.5	5.0	2.6	0.92	95	12	45	30.3
300/130	130	300	248	110	275	115	5	12.5	4.6	2.3	0.85	115	15	55	31.5
300/150	150	300	258	120	275	115	5	14.0	4.4	2.0	0.80	140	18	67	30.0
400/130	130	400	258	110	370	155	7	10.5	4.6	3.1	0.85	120	17	57	32.6
400/150	135	400	258	120	370	155	7	12.0	4.5	2.7	0.80	150	21	71	32.6
400/175	175	400	308	130	370	155	7	13.5	4.2	2.3	0.74	190	26	90	31.4
400/200	200	400	318	145	370	153	7	16.0	3.9	2.0	0.73	230	33	110	31.2

Variables not given in figure are defined as follows:

d_m = inner diameter of the tuyere.

A_m = sum of cross sectional areas of the air jet openings in the tuyeres.

A_h = cross sectional area of the throat.

A = number of tuyeres.

Source: Kaupp 1984a, Table 5; Fig. 75.

