RESULTS

The calculated heat loss from the system is as follows:

1) Reactor, Cyclone, Standpipe and Feed Lines

421 sq. ft. at 100 Bty-hr/sq.ft. or 42,000 Btu/hr

2) Bare metal-slide valve and transfer line connection.

5 sq.ft. at 3000 Btu/hr/sq.ft. 15,000 Btu/hr

Total Reactor Loss 57,000 Btu/hr

3) Steam System

155 sq. ft. at 135 Btu/hr/sq.ft. 21,000 Btu/hr

Total Loss 78,000 Btu/hr

Heat release rates were calculated on the following basis:

	Btu/mol CO Converted
CO_2	16,650
CH_4	94,300
C2, C3, & C4 olefins	68,200
C2, C3, & C4 paraffins	72,500
Oil	68,200

The following tabulations summarize the heat balances and heat transfer coefficients for Runs 3 through 12.

It will be noted that during the earlier runs, 3 through 7, the unaccounted-for heat loss was considerably higher than in the latter runs. This reduction corresponded to the installation of better insulation at this time. Some difficulty has also been experienced from time to time in the measurement of steam production due to surges in steam rate. These surges have resulted from the combined action of the boiler water level controller and the steam back pressure regulator and have now been brought under control.

Figure 1 shows the relation between overall heat transfer coefficient and reactor inlet velocity. It is apparent that the heat tranfer rate is very strongly influenced by velocity, no doubt as a result of the scrubbing action of the turbulent catalyst on the gas film on the cooling tubes and also as a result of the greater turbulence of the catalyst bed itself. It may also be noted that thecurve extrapolates approximately to a gas film heat transfer coefficient at zero inlet velocity.

It should be noted that nearly all of the runs made at Montebello have been in the ramge of 1.5 recycle ratio and that inlet velocity is directly related to heat input.

Figure 2 shows a corresponding relation of inlet velocity to the dense phase heat transfer coefficient. These values were calculated on the assumption that all heat is transferred in the dense phase region of the reactor. There is considerable doubt that this is the case and there is, also, some uncertainty as to the extent of the dense phase, since this, in turn, is calculated on the assumption that the pressure drop measured over the bottom 44.4 inches of the reactor is a true measure of the density of the catalyst throughtout the reactor. It is, therefore, not surprising that the correlation shown in Figure 2 is poorer than that shown in Figure 1.

It should, also, be noted that there is no apparent effect of catalyst density on the overall heat transfer coefficient. This is shown most clearly by a comparison of the successive periods of Run 12 where the catalyst density dropped from 117 lbs./cu.ft. initial density and 71 lbs/cu.ft. in Run 12-D.

Although no data are available to establish the point clearly it is the impression of those who have operated the Montebello Unit that the variation of steam pressure is not a very effective means of controlling bed temperature over wide ranges. Over narrow ranges steam pressure variation appears to be an effective means of control, but over wide ranges it is believed that the ability tochange the amount of cooling surface will be required. This should not be difficult to accomplish in a commercial reactor, will provide a reasonable steam pressure, over wide ranges of cooling rate, and will not introduce excessive temperature differentials between cooling tubes and catalyst bed.

Frequent inspections of the condition of the cooling tubes have been made and no accumulation of oil, wax or catalyst has ever been observed. The tubes are usually coated with a very thin film of sooty material which appears to be catalyst.

MONTEBELLO SYNTHESIS UNIT
HEAT BALANCE DATA
Thousands of Btu per Hour

RUN NO.	HEAT CONTENT OF FEED	HEAT OF REACTION	TOTAL INPUT	HEAT CONTENT OF PRODUCTS	HEAT IN STEAM	TOTAL OUTPUT	HEAT LOST	UNACCOUNTED FOR
3B	199	280	479	179	224	403	76	-2
4A	304	310	615	186	248	434	181	83
4B	262	326	588	187	248	435	153	75
5A	194	294	489	168	148	316	173	95
5B	198	362	560	165	240	405	155	77
7A	238	283	521	162	206	368	153	75
7B	25	374	399	224	0	224	175	97
9A	270	495	765	186	507	694	71	-6
9B	358	504	862	250	507	757	105	27
11A	370	417	787	204	475	679	108	30
12A	354	414	768	243	437	680	88	10
12B	358	435	793	247	497	744	49	-29
12C	357	458	815	241	490	731	84	6
12D	334	449	783	237	490	727	56	-22
12E	359	415	774	238	420	678	96	18

MONTEBELLO SYNTHESIS UNIT
HEAT TRANSFER DATA

RUN NO.	AVERAGE BED TEMP F.	STEAM TEMP F	TEMPERATURE DEFFERENCE F	HEAT CONTENT OF STEAM M Btu/hr	BOILER LOSS	TOTAL TO STEAM	HEAT TRANSFER COEF. Btu/Hr/SqFt/ F. OVERALL	DENSE PHASE
3B	605	535	70	224	21	245	69	318
4A	591	542	49	248	21	269	108	352
4B	597	542	55	248	21	269	96	300
5A	588	544	44	148	21	169	75	282
5B	597	544	53	240	21	261	96	320
7A	586	546	40	206	21	227	111	224
9A	601	546	55	507	21	528	188	368
9B	592	546	46	507	21	528	225	545
11A	605	546	59	475	21	496	165	
11B	625	546	79	437	21	458	272	
12A	603	558	45	437	21	458	200	375
12B	608	558	50	497	21	518	203	277
12C	602	558	44	490	21	511	228	325
12D	610	558	52	490	21	511	193	258

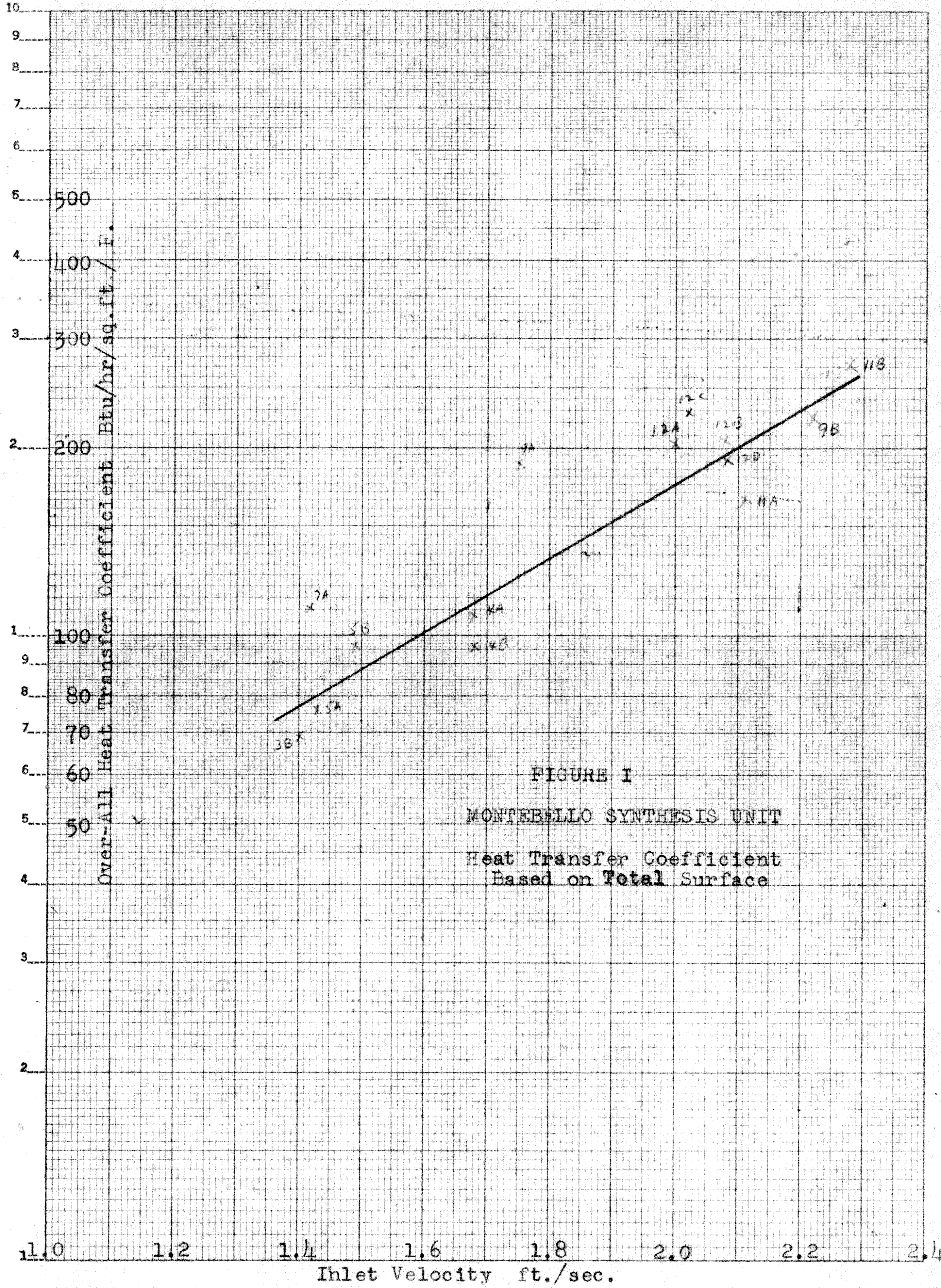

FIGURE I

MONTEBELLO SYNTHESIS UNIT

Heat Transfer Coefficient
Based on Total Surface