TECHNICAL REPORT #1

CREW INTERACTION

WITH THE

"CHIX IN SPACE"

EXPERIMENT

SE83-9

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SPONSOR: KENTUCKY FRIED CHICKEN CORPORATION

The Crew interaction with the "Chix in Space" (CIS) experiment is a very vital one due to the biological nature of the experiment. The CIS experiment will have thirty-two (32) fertilized eggs (Cobb-Male, Arbor Acre-Female). Normal incubation of the chicken embryo is twenty-one (21) days. To gain a better understanding of the embryo's complete development, two groups will be examined. Group I will consist of sixteen (16) eggs that are in the second day of development of the twenty-one (21) day cycle.

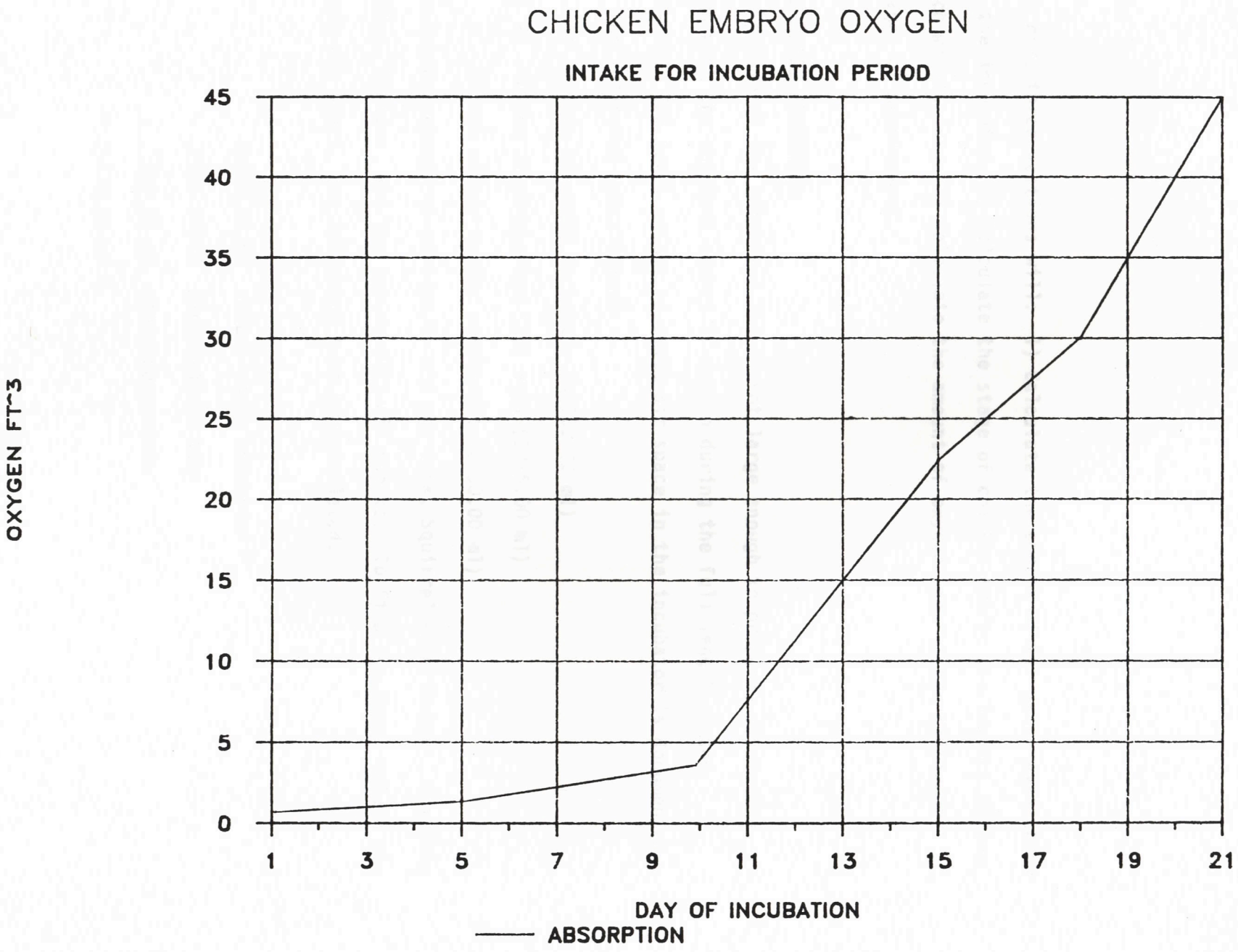
Group II will consist of sixteen (16) eggs that are in the twelfth day of development of the twenty-one (21) day cycle. The "ideal" environment of the incubator consists of the following conditions:

1) temperature 99.5^{o}F
2) relative humidity 65%
3) oxygen level 21%
4) carbon dioxide level .1%.

The environmental control system will maintain the 99.5 ^{o}F temperature within $\pm$ 1^{o}F, but the humidity, oxygen level, and carbon dioxide levels can not be mechanically controlled. This report will outline how each of the three remaining factors should be handled.

<u>Oxygen</u>

The intake of oxygen increases proportionally with the length of embryo development as shown by the following graphs.


CHICKEN EMBRYO OXYGEN
INTAKE FOR INCUBATION PERIOD
OXYGEN FT^3
45
40
35
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
DAY OF INCUBATION
ABSORPTION

The next three sections will: 1) Calculate the amount of air space available in the incubator 2) Calculate the stage of chicken embryo development during each mission day 3) Calculate the amount of oxygen used at the different stages of development.

Air Space Available

The volume of the incubator box is not large enough to properly supply the eggs with the required amount of oxygen during the full length of the mission. The total volume of empty air space in the incubator is documented by the following calculations:

1) Volume of empty incubator (43738.20 ml)
2) Volume of thirty-two (32) eggs (2016.00 ml)
3. Volume of all inside components (2490.00 ml)

The inside components consist of the egg rack, Squirrel meter/logger, humidity probes, heaters, and the twelve (12) air shocks. To find the total volume of empty air space, the following must be calculated.

43738.20 ml volume empty incubator
- 2016.00 ml minus volume eggs
- 2590.00 ml minus components
* 39132.20 ml *

CHICKEN EMBRYO DEVELOPMENT
DURING
EACH MISSION DAY

MISSION DAYS

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
16 eggs 2 days old	16 eggs 3 days old	16 eggs 4 days old	16 eggs 5 days old	16 eggs 6 days old	16 eggs 7 days old
16 eggs 12 days old	16 eggs 13 days old	16 eggs 14 days old	16 eggs 15 days old	16 eggs 16 days old	16 eggs 17 days old

OXYGEN CONSUMPTION
"CHIX IN SPACE"
SE83-9

THE FOLLOWING INFORMATION HAS BEEN DERIVED
FROM THE OXYGEN GRAPH PRESENTED EARLIER IN THE REPORT.

DAY	OXYGEN IN ML.
0.00	11.094
1.00	13.899
2.00	17.415
3.00	21.819
4.00	27.337
5.00	34.251
6.00	42.913
7.00	53.766
8.00	67.364
9.00	84.401
10.00	105.747
11.00	203.051
12.00	306.717
13.00	410.383
14.00	514.049
15.00	617.715
16.00	721.381
17.00	825.047
18.00	928.713
19.00	1032.379
20.00	1136.045
21.00	1239.711

The stage of the chicken embryo development for each mission day has been defined. The volume of oxygen that the chicken embryo consumes on these days has also been defined. The total volume of empty air space and the rate at which the oxygen is used up has been calculated. The times at which the hatch door must be opened to recharge the incubator environment with the proper 21% oxygen level can now be determined.

	Timeline	Day	Egg Stages	Air Needed for 32 Eggs-(21% O_2) Cummulative	Hatch Door Opened
	0 hrs.	1		0 (ml)	
	6	1	16 eggs 2 days old	8,232.38	
	12	1		16,464.76	
	18	1	16 eggs 12 days old	24,697.14	
A	24	1		32,929.52	HATCH OPEN A
	30	2	16 eggs 3 days old	43,241.70	
	36	2		53,553.87	
	42	2	16 eggs 13 days old	63,866.05	
B	48	2		74,178.22	HATCH OPEN B
	54	3	16 eggs 4 days old	86,596.71	
	60	3		99,015.20	
C	66	3	16 eggs 14 days old	111,433.69	HATCH OPEN C
	72	3		123,852.18	
	78	4	16 eggs 5 days old	138,410.09	
D	84	4		152,967.99	HATCH OPEN D
	90	4	16 eggs 15 days old	167,525.90	
E	96	4		182,083.80	HATCH OPEN E
	102	5	16 eggs 6 days old	198,823.23	
	108	5		215,562.66	
F	114	5	16 eggs 16 days old	232,302.08	HATCH OPEN F
	120	5		249,041.51	
G	126	6	16 eggs 7 days old	268,014.27	HATCH OPEN G
	132	6		286,987.04	
H	138	6	16 eggs 17 days old	305,959.80	HATCH OPEN H
	144	6		324,932.56	

At the designated times, the hatch door will be open for *five (5)* minutes.

Carbon Dioxide

The carbon dioxide output also increases proportionally with the length of the embryo's development. By removing the hatch door at the designated times to recharge the incubator environment with the proper 21% oxygen level, the carbon dioxide will also be maintained at the proper levels.

Humidity

The humidity is extremely important for normal embryo growth and development. To maintain the proper 65% relative humidity level the following activity will be conducted each time the hatch door is opened. A capillary pad will be fastened by a Velcro strip to the back of the hatch door. With the circulating fan and capillary pad the ideal humidity can be obtained. When the hatch door is opened, the capillary pad will be replaced. All the replacement capillary pads are secured on the outside of the CIS incubator by Velcro strips. The new capillary pad will be placed on the back of the hatch door and the used capillary pad will take the new pad's place on the side of the CIS incubator. The fresh capillary pads will come pre-charged with the proper quantity of water in an air-tight package that is labeled.

Log Book

A log book will be attached to the side of the incubator by means of a Velcro strip. Each time the hatch door is opened observations should be made. The condition of the eggs after launch and prior to landing should be noted.