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# **PITCH EVALUATION BY BENCH SCALE ANODES MANUFACTURING AND TESTING**

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## **1 Introduction**

It is well-known that overpitched anodes show deformations and cracking as well as packing materials sticking during the baking. Underpitched anodes are too permeable and a poor burning behaviour may occur.

Furthermore due to the fact that binder materials are more expensive than the filler coke, it is of importance to optimize the amount of pitch based on the physical and chemical properties of the baked anode.

The results of the pitch evaluation procedure can also be used for the selection of appropriate or compatible binders for the manufacture of prebaked anodes.

## 2 Binder Testing

The first step of the bench scale study consists of the determination of the binder properties. Different analysis are made according the test schedule below.

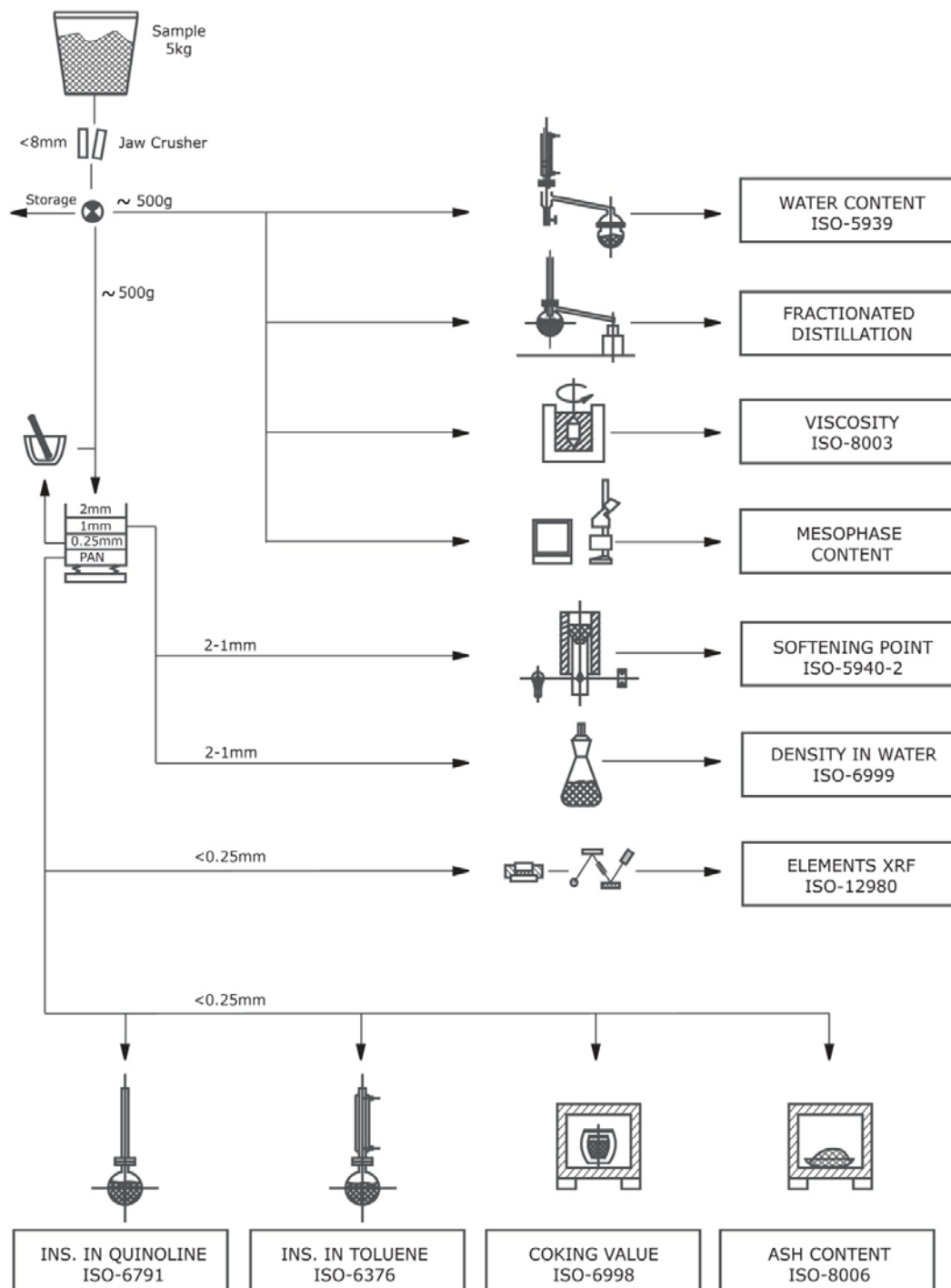


Figure 1: Test Schedule for Binder Properties Determination

### 3 Bench Scale Anodes Preparation and Baking

#### 3.1 Recipes

The dry aggregate used for the bench scale electrodes manufacturing is composed of two petroleum cokes and one butts type, having the properties as shown in the table 1 below.

	<b>COKE 1</b> C12795	<b>COKE 2</b> C12796	<b>BUTTS</b> EE3077
S Content [%]	2.5	1.2	1.8
V Content [ppm]	200	100	150
Na Content [ppm]	-	-	350

**Table 1: Raw Materials Impurities**

The table 2 below indicates the recipe of the dry aggregate.

<b>FRACTION</b>	<b>COKE 1</b>	<b>COKE 2</b>	<b>BUTTS</b>	<b>TOTAL</b>
[mm]	[%]	[%]	[%]	[%]
8-4	2.7	1.3	10.0	<b>14.0</b>
4-2	5.3	2.7	6.0	<b>14.0</b>
2-1	6.7	3.3	4.0	<b>14.0</b>
1-0.5	7.3	3.7	3.0	<b>14.0</b>
0.5-0.25	8.0	4.0	2.0	<b>14.0</b>
FINES 3500 Blaine	20.0	10.0	0.0	<b>30.0</b>
TOTAL	50.0	25.0	25.0	100.0

**Table 2: Recipe for Dry Aggregate Preparation**

The recipe presented in the table 2 has been chosen in order to obtain typical properties for the bench scale electrodes when using a typical coal tar pitch.

To determine the effect of the binder content, four recipes are prepared having the following levels of pitch addition:

- 13 % pitch content
- 14 % pitch content
- 15 % pitch content
- 16 % pitch content

### 3.2 Forming

A flow sheet of the bench scale electrode production is shown in figure 2 below. The recipes are preheated in an oven at 200°C for 12 hours and a 10 litre intensive Eirich mixer is then heated to 60°C above the average Mettler softening point of the typical pitches (typical is around 112°C). To the 4 kg standard recipe, granular standard pitch is added, and then mixed for 10 minutes, this being the time necessary for the green paste to reach a temperature of 172°C.

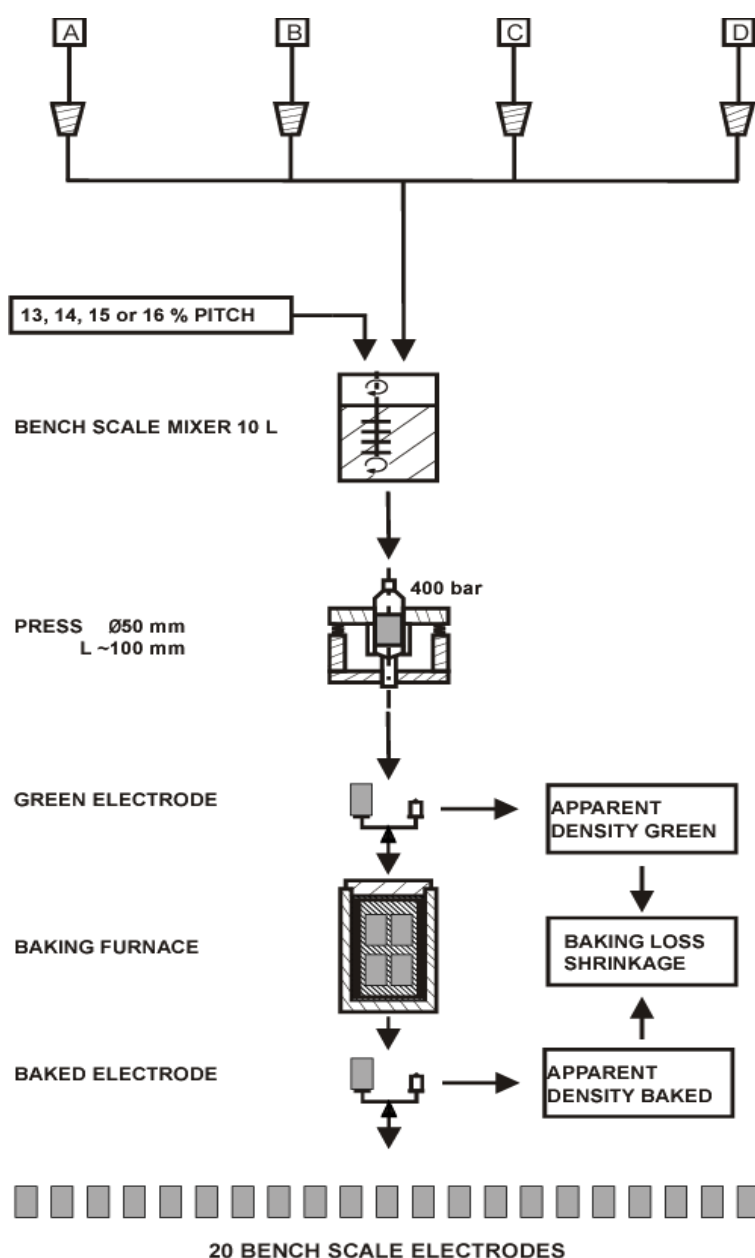


Figure 2: Process Flow Sheet of the Bench Scale Electrode Production

The hot paste is then pressed in a pre-heated (100 – 120°C) floating mould press for one minute at 80 kN, this corresponding to a specific pressure of about 400 bar. The complete unit including mixer, press, and hydraulic device is shown in figure 4 below.

For each pitching level, 20 bench scale electrodes are pressed.



**Figure 3: RDC 161 Bench Scale Anode Production Unit**

### 3.3 Baking

The set is baked in an electrically heated furnace (5 kW) using petroleum coke (2–1 mm) as packing material. The furnace and control unit are shown in figure 5. For the baking of the electrodes, three different temperature gradients are used according to the table 3.

Temperature	Gradient
20 to 150°C	100°C/h
150 to 300°C	10°C/h
300 to 1100°C	50°C/h

**Table 3: Baking Program**

The heat soaking time at 1100°C is 20 hours.

The apparent density of the bench scale anodes are measured before and after baking and the baking loss and shrinkage calculated.



**Figure 4: RDC 166 Anode Baking Furnace BF12 A**



## 4 TESTING OF BENCH SCALE ANODES

The measurement of the physical and chemical properties is performed on 20 bench scale electrodes according to the test schedule shown in figure 6.

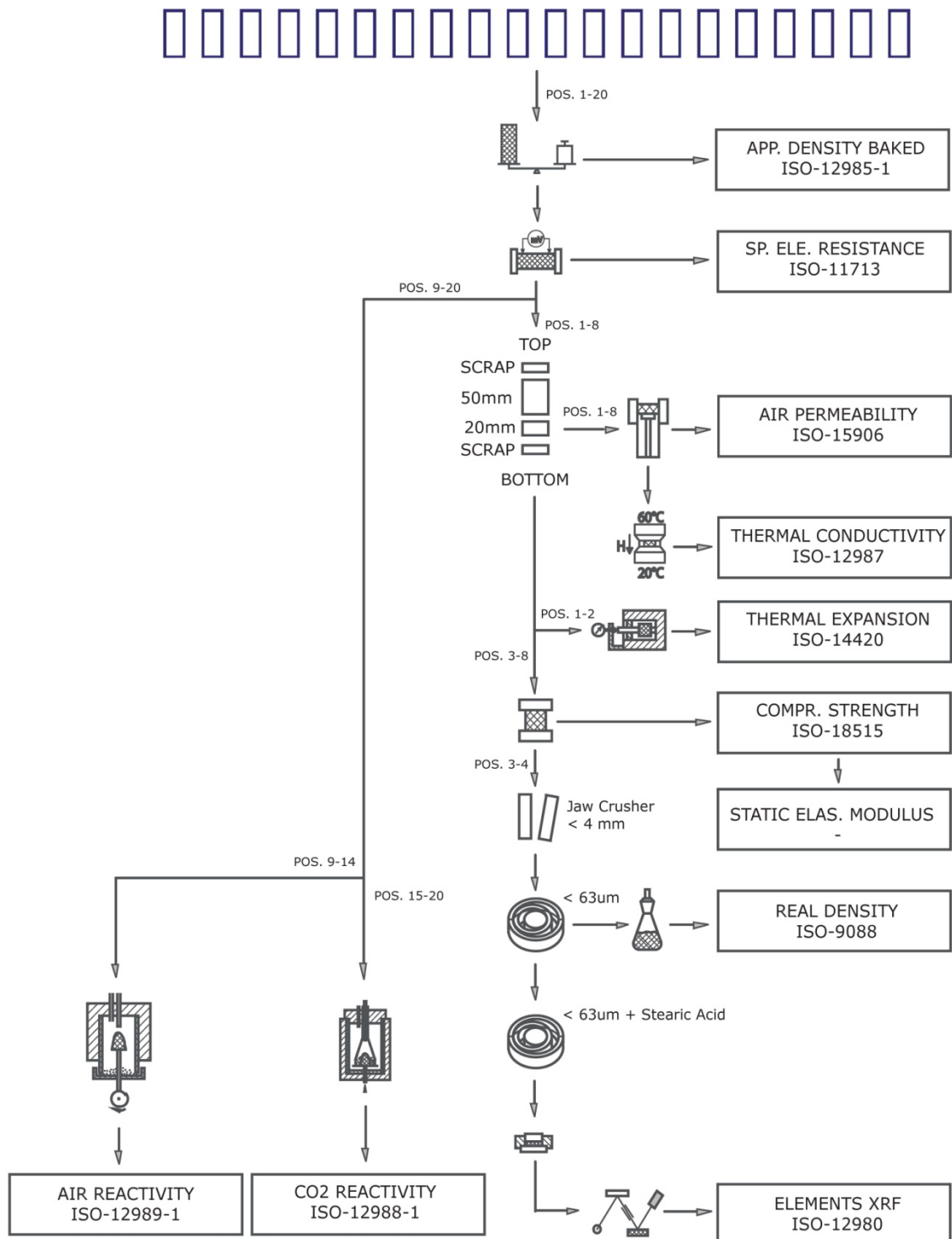


Figure 5: Test Schedule for Bench Scale Electrode Analysis

## **5 PRESENTATION OF RESULTS**

The results are presented in tables in the form of diagrams as shown in figure 6 and figure 7. The range of results obtained from 40 different bench scale pitch evaluations with identical filler coke standard recipes is shown as the grey area in the diagram.

**R&D**

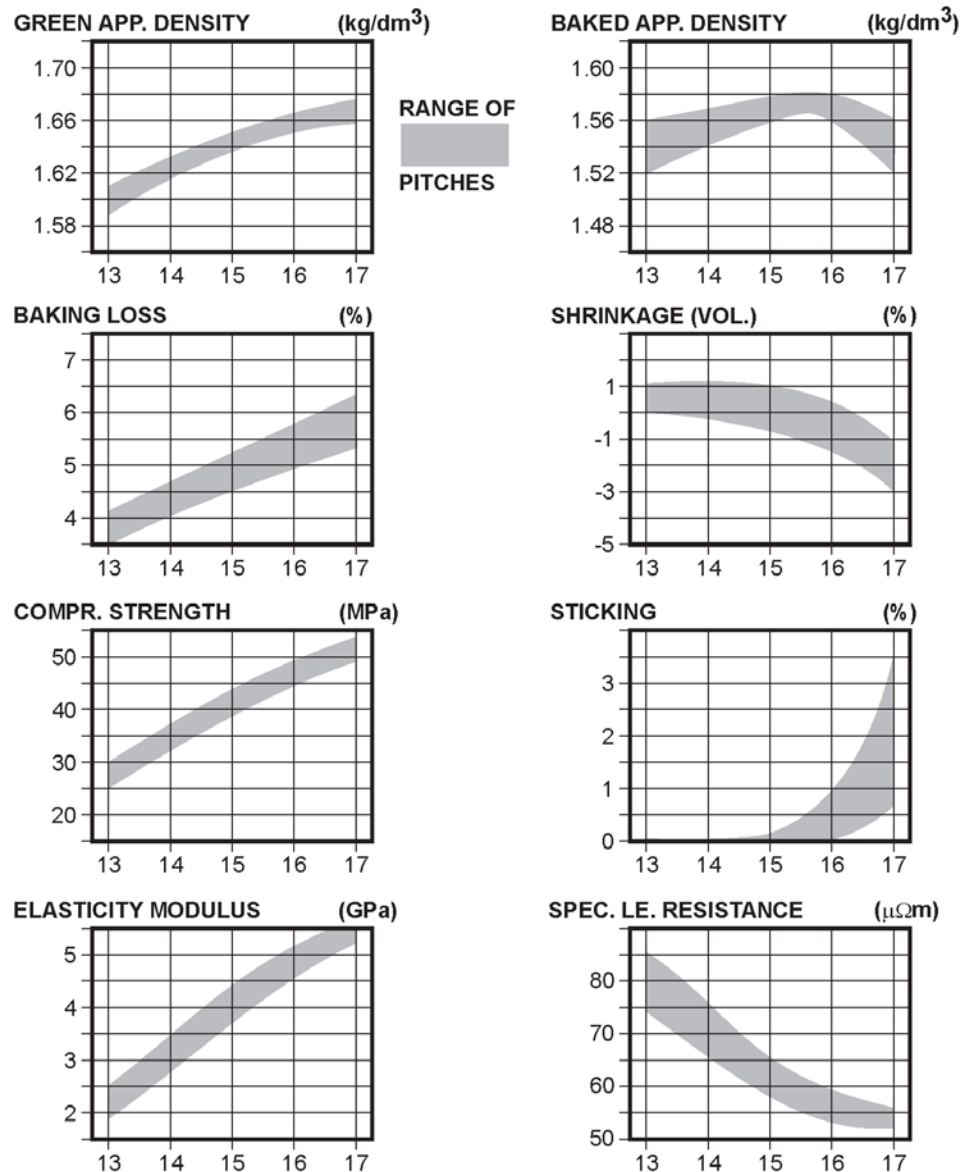
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## EVALUATION OF PITCH

ANODE Physical / Electrical Properties

PITCH : B/...  
COKE : C/...  
BUTTS : ... %

RECIPE : ...  
REF. : ...



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Figure 6: Presentation of Bench Scale Results: Anode Physical and Electrical Properties

**R&D**

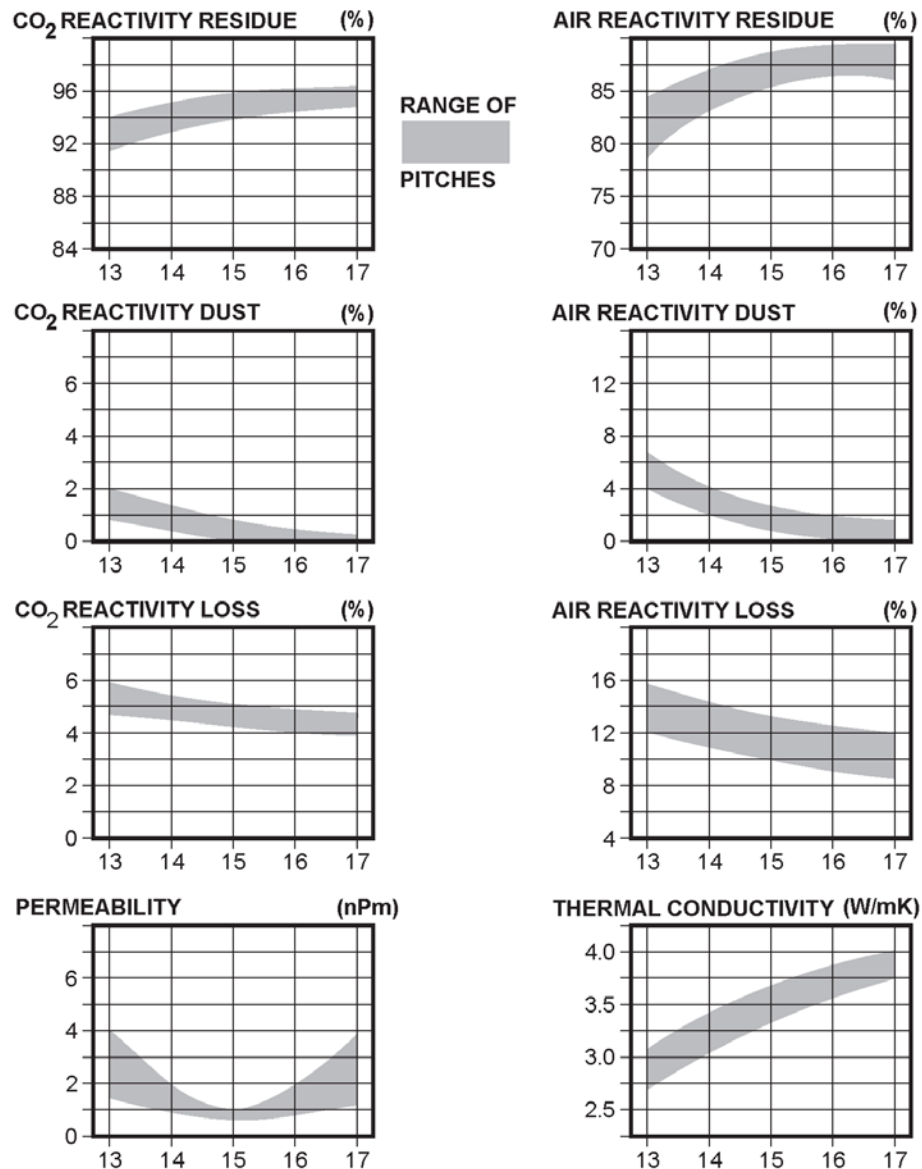
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## EVALUATION OF PITCH

### ANODE Burning behaviour properties

PITCH : B/...  
COKE : C/...  
BUTTS : ... %

RECIPE : ...  
REF. : ...



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Figure 7: Presentation of Bench Scale Results: Anode Burning Relevant Properties