CONTINUOUS VACUUM PAN – AN ATTEMPT FOR DUAL MASSECUITE BOILINGS WORKING

By

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Abstract

THE CONTINUOUS vacuum pan is a boon to the sugar industry by nature of its high heating surface to volume ratio, constant steam demand, more exhaustibility of the massecuite, crystal growth, easy to automate, easy to operate, flexibility in capacity and so on. In Ponni Sugars, one continuous pan of 15 t/h capacity was installed five years ago. Taking advantage of its working pattern, an attempt was made to modify its design slightly to convert the pan from a single massecuite-boiling pan into a double massecuite-boiling pan. The practical experiences are shared in this article.

Introduction

Ponni Sugars (Erode) Limited underwent an expansion from 1250 tcd to 2500 tcd in 1994. This was done by installing limited and essential equipments, keeping the investment cost at minimal levels with no provision for additional built-in-capacity.

As a result, Ponni lost the advantage for crushing higher than the rated capacity and could achieve no more than 2250 tcd crushing on an average during any season since the expansion.

The pan section was no exception to this and solids handling with the improved cane variety, and demand for sugar quality with higher crystal size from the market added fuel to the problems. So a decision was made to install a continuous vacuum pan (CVP) of 15 t/h capacity for boiling C massecuite which was subsequently erected and commissioned during 2004.

Continuous pan

The newly erected CVP was operated for C massecuite boiling right from its inception. For two years, the practice was followed. During the operation, it was found that the boiling rate was found so high such that the pan was working only about 10–12 hours a day, the rest of the time being kept idle. Starting and stopping the pan was posing a big problem to the operators. The operational data are enclosed in Appendix 1.

The pan was operated with part automation wherein the molasses feed was added to maintain the consistency of material inside the compartment and the seed was fed at a ratio to the molasses flow rate by using a ratio controller. The automation arrangements are shown in Figure 1.

Modifications made to the CVP

Since this continuous pan was operated in a discontinuous way i.e. the pan was operated for about 10–12 hours per day, several options were considered regarding the working of the pan. These included:

a. to reduce the number of compartments; and

b. to alter the design of the pan to suit working with two massecuites (i.e. B and C massecuites).

The second option was chosen because the existing continuous pan for B massecuite was also getting corroded badly and was incurring huge maintenance expenditure year after year.

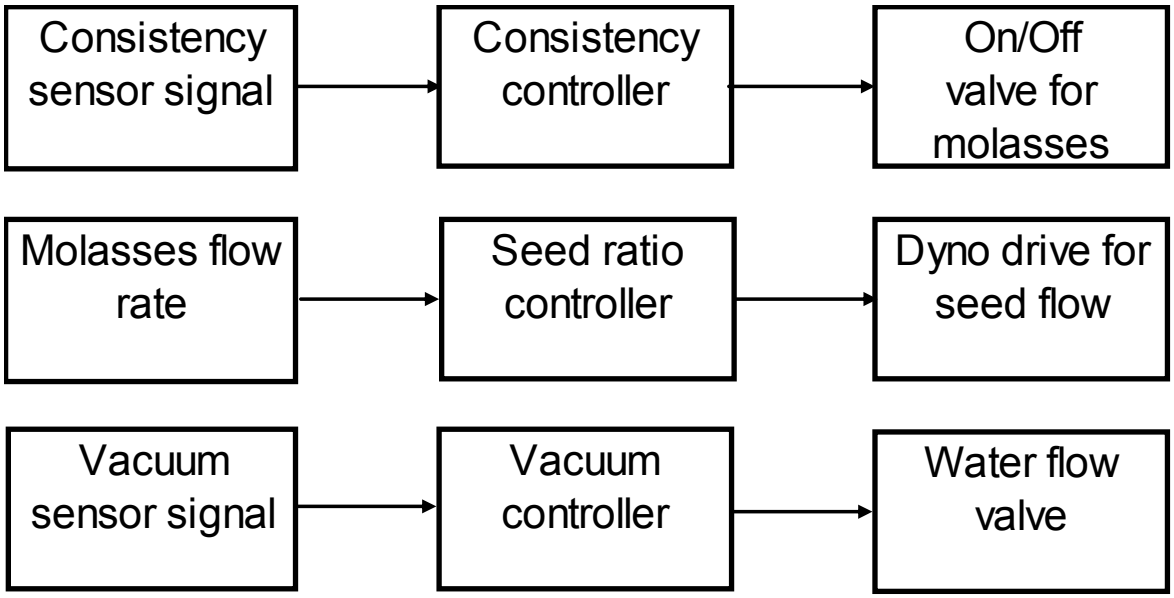

Fig. 1—The three main control loops on the CVP prior to the modifications.

Since the design of the new CVP was suitable for the proposed modifications to boil two massecuites, the following modifications were made:

- The CVP was divided lengthwise into two on the vertical plane with respect to the compartment on either side of the top tube plate.
- Necessary changes to the flow path to ensure true plug flow of the massecuite in the different compartments.
- Feed liquor arrangements suitably rearranged to give better mixing of liquor and exhaustion of mother liquor in the CVP.
- Steam distribution divided into two to allow the use of vapour of different pressures for each massecuite.
- The compartment partition plate above the top tube plate was modified to avoid any short-circuiting.
- Plug flow of massecuite was achieved by rearranging the massecuite flow pattern.
- The existing condenser nozzle sizes were increased to suit the increased rate of evaporation.
- Existing partial automation was upgraded to complete automation.

The modifications are illustrated in Figures 2 and 3.

Operation of the modified CVP

After the modifications were completed but before the automation was completed, the CVP was recommissioned in 2006. Initially a lot of teething troubles were encountered as complete automation was not available. Since the CVP working efficiency depends wholly on the automation, efforts were concentrated on this aspect. Changes made to the automation system included:

- Existing sensors and transmitters were replaced by reliable and user-friendly equipment.
- VFD arrangements made for pumping B and C footing material.
- Control valves were replaced by proportionate type control valves for On/Off mode.
- Vapour valves were provided with proportionate type control valves.

- Jigger steam arrangements were provided to the bottom of the pan.
- Hot water addition on auto mode provided for further conditioning of molasses.

The logic of the automation is shown in Figure 4.

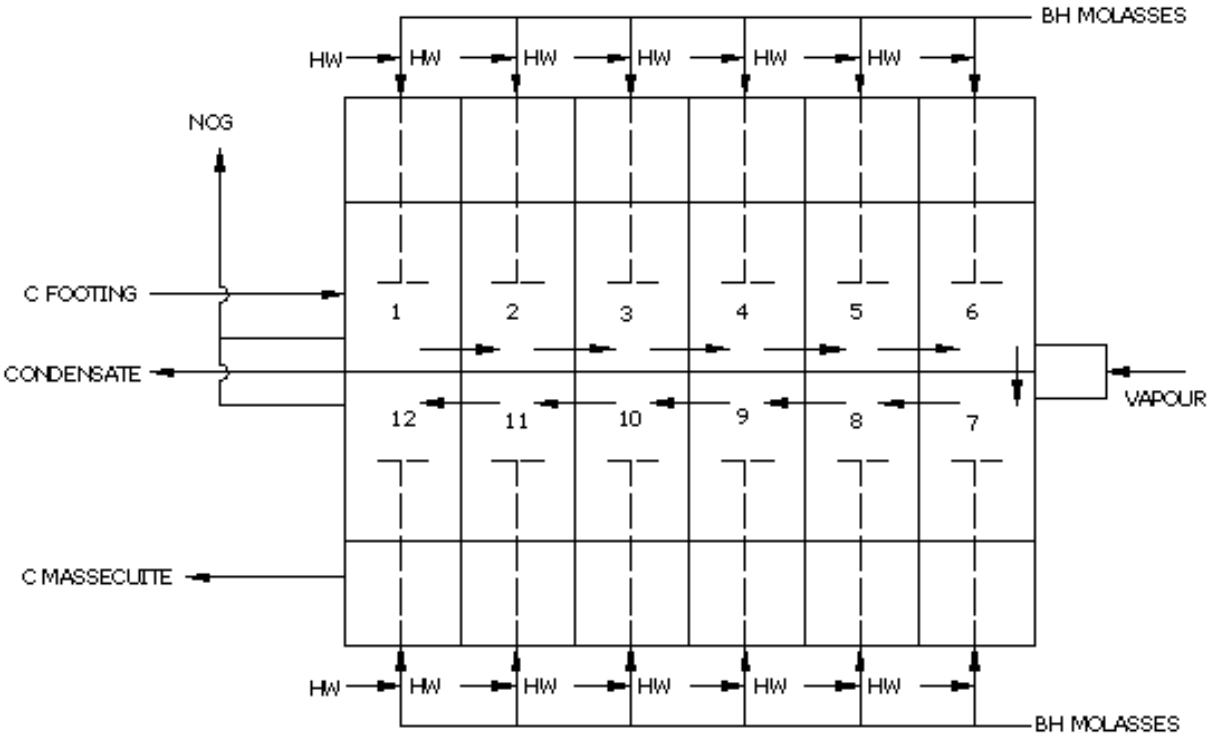

Fig. 2—Material flow diagram for C massecuite boiling in CVP before modification.

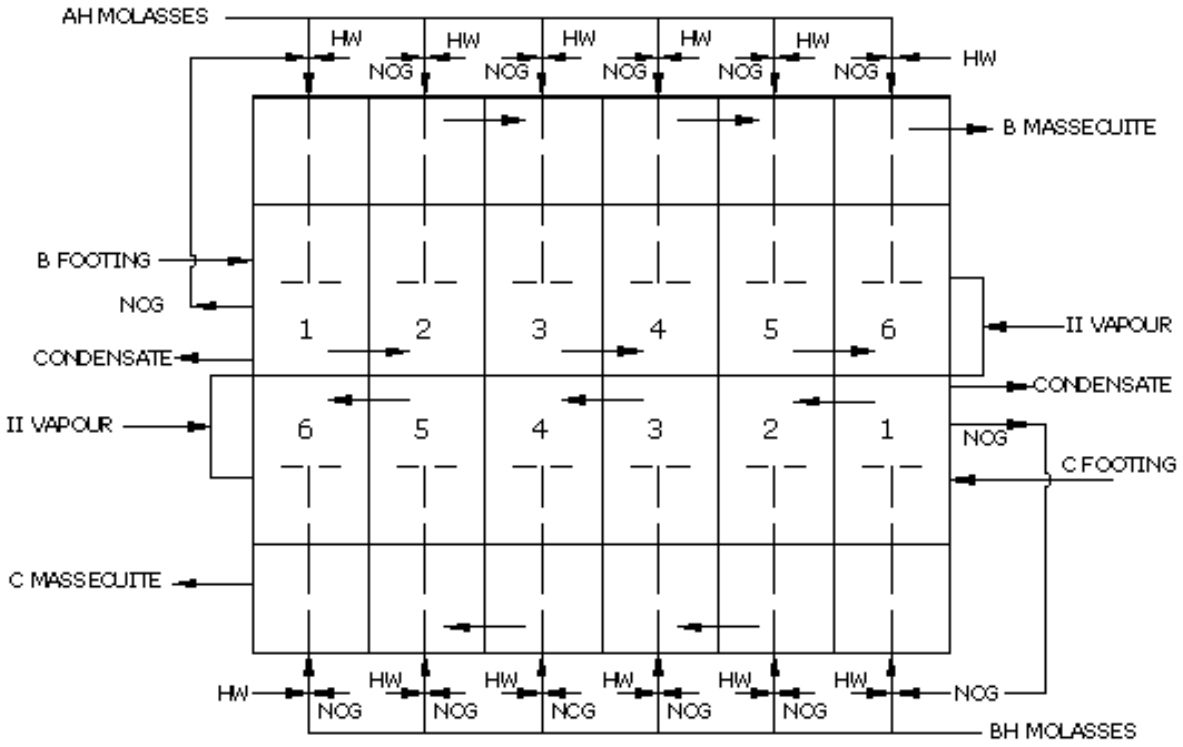

Fig. 3—Material flow diagram for dual massecuite boiling in CVP after modifications.

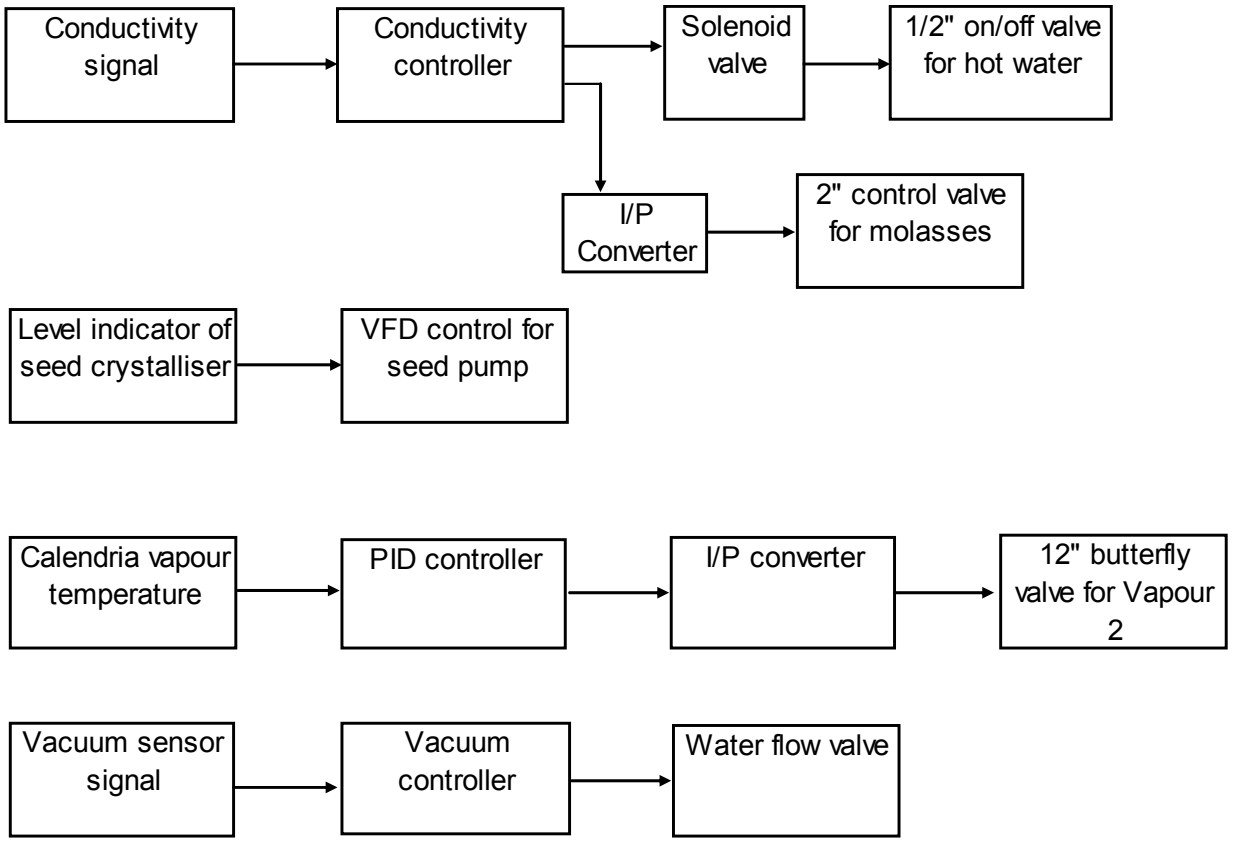

Fig. 4—Automation arrangements for the modified CVP.

All the above improvements were made and the pan started working very well on fully automatic mode. The following benefits were noted:

- Throughput from the pan was increased without affecting the efficiency.
- The pan was utilised for the maximum hours of working.
- The flows of massecuites are uniform and centrifugal machines are continuously loaded.
- Improved evaporator performance due to constant steam demand.
- Since start up and stopping operations are avoided, deposits are avoided.
- Automation helps in flexibility to vary throughput according to crushing variations.
- The same logic can work very well for independent massecuite boiling also because of effective steam utilisation.

The data collected during the working of the pan with both massecuites are given in Appendix 2.

Conclusion

This novel concept of making the CVP as twin pan was conceived by the author Mr R. Chandamouli and successfully implemented in Ponni Sugars (Erode) Limited. Because of this modification work, not only was the pan utilised to its maximum capacity but also assisted to ease the solids handling on the pan floor. The total cost incurred for the modification works was around Rs. 4.00 lakhs.

It is well known that continuous pans work well only with full automation. Only with full automation did this pan succeed to work well for dual massecuite boiling. The rate of evaporation was found to be constant throughout the operational period. Whenever the pan had to be stopped for more than 4 hours, the contents were emptied, water boiled and again taken into service.

Appendix 1
Performance of C massecuite boiling in continuous vacuum pan before modification

Date	Cane crushed, (t)	BH Molasses ty/day (t)	C Footing		C Massecuite			Boiling ours
			Qty (t)	Crystal size (µm)	Qty (t)	Crystal size (µm)	% Cane	
09/03/03	2695	178	68	102	193	159	7.26	12.0
10/03/03	2655	182	66	108	195	164	7.36	13.0
11/03/03	2650	176	67	112	193	172	7.23	14.0
12/03/03	2675	184	70	106	199	164	7.42	12.0
13/03/03	2685	178	68	98	196	150	7.44	12.0
14/03/03	2630	170	67	108	186	162	7.17	12.5
15/03/03	2600	176	67	110	192	168	7.23	14. 0
16/03/03	2660	167	66	114	184	170	6.63	13. 5
17/03/03	2775	172	69	104	191	158	7.29	12.0
18/03/03	2620	168	66	113	185	174	7.05	14.0

Appendix 2
Performance of B massecuite boiling in continuous vacuum pan after modification

Date	Cane crushed (t)	AH Molasses qty/day (t)	B Footing		B Massecuite				Boiling hours
			Qty (t)	Crystal size (µm)	Qty (t)	Crystal size (µm)	CV %	%Cane	
01/02/08	3525	356	148	228	404	370	29	11.48	22.15
02/02/08	3580	367	150	243	418	368	19	11.89	21.0
03/02/08	3610	367	152	230	424	363	22	11.74	22.0
04/02/08	3400	345	143	222	394	373	21	11.59	22.0
05/02/08	3300	335	138	248	388	371	21	11.70	22.0
06/02/08	3590	360	150	236	412	375	21	11.49	21.0
07/02/08	3455	350	148	244	407	373	21	11.77	21.75
08/02/08	3660	370	153	229	427	368	20	11.87	21.0
09/02/08	3460	350	148	230	405	351	18	11.70	22.0
10/02/08	3260	354	137	216	398	330	27	12.19	20.5

Performance of C massecuite boiling in continuous vacuum pan after modification

Date	Cane crushed (t)	BH Molasses Qty/Day (t)	C Footing		C Massecuite				Boiling hours
			Qty (t)	Crystal size (µm)	Qty (t)	Crystal size (µm)	CV %	%Cane	
01/02/08	3525	230	93	136	259	199	24	7.35	22.0
02/02/08	3580	224	93	135	259	206	17	7.22	22.5
03/02/08	3610	235	96	131	264	208	22	7.31	22.5
04/02/08	3400	213	88	138	244	214	21	7.18	22.0
05/02/08	3300	214	88	128	245	217	20	7.42	20.5
06/02/08	3590	233	96	127	264	207	22	7.36	21.0
07/02/08	3455	222	91	142	255	201	18	7.37	20.5
08/02/08	3660	233	96	128	266	200	21	7.27	22.5
09/02/08	3460	219	93	135	254	197	23	7.34	22.5
10/02/08	3260	217	88	120	244	181	18	7.49	20.0

Note: CV data not available before modifications

CUITE CONTINUE—UNE TENTATIVE POUR LE TRAITEMENT DE MASSECUITE DOUBLE

Par

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MOTS-CLEFS : Cuite Continue, Rapport Surface de Chauffe/Volume, Taux de Semences, Contrôleur Ratio, Emetteur de Conductivité, Lecteur Dyno, Automatisation.

Résume

LA CUITE continue apporte beaucoup d'avantages pour l'industrie du sucre; par exemple le fort rapport de sa surface de chauffe au volume, une demande constante de vapeur, un fort épuisement de la mêlasse, une bonne croissance cristalline, automatisation et travail faciles, flexibilité dans la capacité, et ainsi de suite. Une cuite continue a été installée à Ponni Sugars avec une capacité de 15 t/h, il y a cinq ans. Une tentative pour modifier sa conception légèrement afin de permettre le traitement de massecuite double a été faite. Les expériences pratiques sont partagées dans cet article.

TACHO CONTINUO—UN INTENTO PARA COCIMIENTO DUAL DE MASAS

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PALABRAS CLAVE: Tacho Continuo, Razón Área/Volumen, Tasa de Semillamiento, Controlador Proporcional, Transmisor de Conductividad, Dyno Drive, Automatización.

Resumen

EL TACHO continuo es importante para la industria azucarera en razón de su alta relación de área de calentamiento a volumen, demanda constante de vapor, mayor agotabilidad de las masas, crecimiento de cristal, facilidad de automatización y operación, flexibilidad en capacidad y así sucesivamente En Ponni Sugars, un tacho continuo de 15 t/h de capacidad fue instalado hace 5 años. Aprovechando su esquema de funcionamiento, se intentó modificar ligeramente su diseño para convertirlo en un tacho para cocimiento de doble masa. En este artículo se comparten las experiencias.