THE QUANTITY OF THE METAL IN THE FRAME CONSTRUCTION – QUALITY INDICATOR

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ABSTRACT
In the most fully plastic deforming machineries the frame body represents 50-70 % from the whole press weight.
The paper analyses – comparative – some different criteria of appreciate of the metal quantity used in the construction of hydraulics presses a quality indicator of the realized products.

1. GENERALITY

From the high quality points of view and the cut rate of the products with is realised by the plastic deformation equipments are depending upon the construction of the equipments on which it is made. Due to of the constructive characteristic, at the majority plastic deformation equipments, the framing plate represents 50-70% from the table equipments itself.
In the analyses of the economic advantages and the development's possibility of some constructive type of equipments, the relation between the weight of the equipments and the nominal force, are one of the quality factor most used.
For example with the speciality literature, in the hydraulics presses domain, this relation has a fluctuation between 0,003-0,0095 at the pre-tension presses. 0,05-0,1 at the classics, with columns and 0,03-0,04 at the frame presses size.
The function measure used, this indicator named also "indicator of weight per brake, I" definite with the relation:

$$I = G/F \quad [kg/tf]$$

Where G represents total weight, and F, the maxim pressing force, it has value to 100 and 200 amounting outrace of 300 for the studded group of the hydraulics presses.
In the same direction the speciality literature used also the "coefficient of metal quantity" $k_M = \frac{M}{P_H}$ it means the ratio of the press plate properly (M, in ton) and the nominal force (P_H, in tf).
In the idea of the unit signification it is considered the notion of the "table indicator, I_m definite trough:

$$I_m = k\frac{m}{F_n} \qquad [t/MN] \qquad (1)$$

(where m, is the total press plate in ton, F_n, nominal pressing force in MN and k, is the coefficient of correction which take care of the various table function of course of the pile driver and the dimension of the table equipment's) exactly evaluated this synthetic indicator used frequently in the assessment of the metal quantity.
For k = 1, the table 1 synthesises the values of the "table's indicator I_m", established for some varied technological groups of hydraulics presses.

TABLE 1. THE VALUE OF THE TABLE'S INCICATOR I_m FOR VARIOUS TECHNOLOGIC GROUPS OF PRESSES

Nr. crt.	The technologic groups of presses	I_m [t/MN]
1	Presses for the metal synthesis extra hard	0,3 – 0,7
2	Presses for cold compressing - salience	0,4 – 1,0
3	Drop presses with over force 100 MN	2,0 – 6,0
4	Balling presses	3,0 – 5,0
5	Universal presses with one mullion	4,0 – 8,0
6	Automatic presses for metallic powder. Multi stage presses	4,0 – 12,0
7	Frame chasing hammer	6,0 – 10,0
8	Tubing presses	8,0 – 14,0
9	Presses for cold compressing	10,0 – 20,0
10	Forging presses. Chasing hammer, kerbstone presses, with one mullion	12,0 – 24,0
11	Chasing hammer with double effect	15,0 – 30,0
12	Bale presses for metallic sweeping	15,0 – 40,0

This table indicator I_m has a fluctuation between 0,3 and 40,0, and admits some observation:

- the inferior value is in concordance to the big presses power, but with little dimension of work space and with a little course for the slipper (the presses for the diamante synthesis and for hard alloys, presses for calking and cold compressing etc. For example, in Japan they used a press able to assure the admixture of the agglomerated cake with the pressure 10,07 TPa – 650000 t/sq.in.);
- the upper values will be found at the presses with big dimensions of the plate and with big courses (the forging presses, multi stages presses, chasing hammer etc);
- although with the technological possibility are biggest, the technical level – under angle the metal consumer – is more low for the presses with big courses or big dimension of their plate, confirmation by the big value of the table indicator, will showing the bigger of the plate construction (for examples, the realization of some technological task rigidity, demanded a several dimension with the direct consequence in a bigger plate construction of the equipment and sow the bigger value of the indicator of table);
- in the layer of the presses of same technological group, the ratio at extremity value of the indicator of table fluctuation are 1,5 and 3,0;
- the designer can influenced sensible the indicator table value about the options and elaborated the quality of construction solution and energetic, the precisions in the resistance calculus of construction, by the resistance reserve value used etc.

The option of the material chosen with the upper characteristic mechanic used by the some special technologies (for example, contact slag welding) or used the strain elements to make up the component used by the designer towards to the reduction of the plate construction, reduction reflected by the table indicator value. The calculus methods used the finite elements and the performances computers, the departure of the experimental study of the strain and

deformation with the constructive model function at scale (by electrical resistive tensometry, by photoelasticity), admitted to the designer establish the structural optimal size of the resistance of the equipment and imply reduce the metal quantity.
Other criteria of estimation the metal quantity used in the construction of the hydraulic presses are the following relations:

$$\frac{\text{maximal pressing force} \quad (\text{tf})}{\text{plate presses itself} \quad (\text{t})}$$

or one eloquently principle (but without indication of some symbol in the present the principle to appreciated the metal quantity)

$$\frac{\text{pressing force}(\text{tf}) \text{ x pressing course } (\text{m}) \text{ x area table } (\text{m}^2)}{\text{plate presses itself} \quad (\text{t})}$$

2. THE DETERMINATION OF THE CORRECTION FACTOR

Reducing factor k' bring in [2] affects the metal quantity factor k_M, since the arithmetic mean value opposed the free vertical open value (h), at maximal course to the working element (s), plate dimension (length, l and width l_1):

$$k' = \frac{\frac{1}{h} + \frac{1}{s} + \frac{1}{l} + \frac{1}{l_1}}{4} \qquad (2)$$

For expression to the plate function fluctuation of the modification to the working element and the dimension of the plate equipment, proposed the relation:

$$k = k_1 \cdot k_2 \cdot k_3 \qquad (3)$$

where:

k_1 – correction factor will show the fluctuation of the plate equipment function of the modification of the course of the working element;

k_2 – correction factor will indicate the fluctuation of the plate equipment with the modification of the length plate;

k_3 - correction factor will indicate the fluctuation of the plate equipment with the modification of the width of plate;

The partial correction factor k_1, k_2 and k_3 of the determination it makes modify the ratio courses of maximal dimension plate equipment, at the mean value, corresponding to technological group studied, where it takes part the analysed equipment [2]. All the arithmetical mean value group from the type dimension press – reference frame – they will have the subscript “r”.
At the development courses of the working element s $\Delta s = s - s_r$, with a total high of the press H, it makes biggest with $3\Delta s$ (formed by the augment extension of the hydraulic cylinder with Δs and a free gateway on vertical with $2\Delta s$). Contemplation that the press plate it will be distributed equable on the high, the variation of the press plate it will be proportional with the rapport $3\Delta s/H_r$ and then

$$k_1 = 1 - \frac{3\Delta s}{H_r} \qquad (4)$$

● at the biggest size of the plate length 1, the high of the feeble sleeper h_t and in consequence the sleeper plate m_t go up approximately with the rapport of 3/2. This dependency approximated of the sleeper high variation in the function of the fluctuation table length it will be demonstrated for the particular case at the central application load.
Considerate the transversal rigidity of the mullion being smaller in opposite with the sleeper rigidity (EI product) the sleepers can be reduce at the anchoring beam, simple supported at the ends.

By equivalence of the tension in the most bending section, $\sigma = \sigma_r$ or $M/W = M_r/W_r$, when the bending moment is M= Fl/4 and the coefficient of resistance the length sleeper c is $W = \frac{ch_t^2}{6}$, it is: $h_t = h_{t_r}\sqrt{\frac{l}{l_r}}$.

According with this, the ratio of the sleeper's plate at the specific weight γ is:

$$\frac{m_t}{m_{t_r}} = \frac{clh_t\gamma}{cl_r h_{t_r}\gamma} = \left(\frac{l}{l_r}\right)^{3/2}$$

Absolute schedule Δm_t of the sleeper plate it will be:

$$\Delta m_t = m_t - m_{t_r} = \left[\left(\frac{l}{l_r}\right)^{3/2} - 1\right] \cdot m_{t_r}$$

As long as the sleeper plate it will be considerate a multiple n at the press plate, m_r: $m_{tr} = n \cdot m_r$, for the presses with the layer size frame and n = 0,6, and for the presses with the columns frame [2]), the correction factor who indicate the fluctuation of the equipment plate qualified the table length resulted.

$$k_2 = \frac{m_r}{m_r + \Delta m_t} = \frac{1}{1 + n \cdot \left[\left(\frac{l}{l_r}\right)^{3/2} - 1\right]} \qquad (5)$$

● The same with the demonstration relationship $k_1 = 1 - \frac{3\Delta s}{H_r}$, the reducing factor of the length plate of herself, l_1, it will be:

$$k_3 = 1 - n\frac{\Delta l_1}{l_{1_r}}, \qquad (6)$$

where $\Delta l_1 = l_1 - l_{1_r}$.

3. INDICATOR OF THE TABLE ANALISES

In the table 2 you can found the synthesis of the upper affirmation for two big groups of drops presses by 100-160 MN and drop presses for bigger tons by 300-400MN.(table 2) .
We can see the last observations, been in some examples about the used equipment:

- seeing the example of the Loewy press, opposite with the mean value, F_n increase by 0,82, but all the dimensions (s, h, l, l_1, H and m) increase by 1,067, linear dimensions (s, h, l, l_1, and H) by 1,061 increase opposite by the mean increase plate by 1,094.

The example of the press PHMMD with F_n = 500 MN provide those mean value F_n increases by 1,3 all the linear dimensions and the plate by 1,21, and but just the linear dimension by 1,11, when the plate indicator increased by 1,31, 1,25 and several by 1,14.
The press with F_n = 300 MN release those the mean values a reduced of nominal force by 0,78, all the linear dimension and a reduced of the plate by 0,91, and just the linear dimension presents a reduced by 0,95, when the plate indicator reduced by 0,91, 0,98 and several by 0,8.

TABLE 2. THE ANALYSIS OF THE METAL QUANTITY USED IN THE PREPARED OF THE FRAME DROP PRESS

Nr. crt.	Denomination of the parameter	Symbol	Unit of measuremet	DROP PRESS							
				100-160 MN			BIGGEST TON				
				Mean value	π 5250 URSS	150 MN	Mean value	Press LOEWY	PHME URSS	Cameron Livingstone Anglia	Press by 300 MN
0	1	2	3	4	5	6	7	8	9	10	11
1	Nominal pressing force	F_n	MN	142,9	100,0	150,0	382,5	315,0	300,0	300,0	300,0
2	Maximal courses of working element	s	m	1,02	1,25	1,40	1,73	1,83	1,80	3,05	1,80
3	Free vertical gateway	h	m	2,45	2,25	2,50	4,04	3,60	3,00	6,36	2,70
4	Plate dimension: length	l	m	2,96	2,65	6,00	8,24	9,30	10,00	3,40	10,0
5	Plate dimension: weight	l_1	m	1,68	1,50	2,00	3,73	3,66	3,30	3,58	3,47
6	Total augment of the press	H	m	13,20	14,80	15,83	27,27	34,0	22,08	19,79	24,64
7	Plate press x10^3	m	t	0,94	0,55	2,0	7,31	8,0	6,52	2,68	5,20
8	Correction frame conformable of relation: (2)	k'		0,58	0,57	0,445	0,304	0,301	0,323	0,265	0,329
9	Correction frame conformable of relation: $k_1 = 1 - \frac{3\Delta s}{H_r}$	k_1		1,034	0,947	0,971		0,989	0,992	0,855	0,992
10	Correction frame conformable of relation: n = 0,5; (5)	k_2	-	1,09	1,083	0,515	-	0,909	0,856	1,581	0,856
11	Correction frame conformable of relation: n = 0,5; $k_3 = 1 - n\frac{\Delta l_1}{l_{1r}}$	k_3		1,01	1,054	0,905		1,009	1,058	1,02	1,035
12	Correction frame conformable of relation: $k = k_1 \cdot k_2 \cdot k_3$	k		1,138	1,081	0,453		0,907	0,898	1,379	0,879
13	Plate indicator: k = 1			6,58	5,50	13,33	19,12	25,40	21,74	8,93	17,33
14	Plate indicator: k'	I_m	$\frac{t}{MN}$	3,82	3,135	5,93	5,81	7,64	7,02	2,37	5,70
15	Plate indicator: k			7,49	5,95	6,03	-	23,03	19,53	12,31	15,23

4. CONCLUSIONS

- Make the metal quantity considered, used in the equipment construction by the plastic deformation it is recommended the compared with the mean value of the parameter principals of the technological group where make apart from the equipment
- But the mean value in the stabilisation corresponding of the technological group at the big dispersion of the dates it is necessary for establish mean ponderate. Due to of this means value constitute reference frame to appreciate the metal quantity, an quality frame of equipment, being necessary to keep the calculus of many characteristic of the presses from studying group, with a stronger limit of some typodimension of equipment.
- You can anticipate the equipment plate bellow that it will be build up and it will be directed by the indicator plate of mean value (for example, the table indicator value reduced to material chose with the superior characteristics, because this can reduced the equipment plate).
- Those mean value of the technological group takes in study, the table indicator I_m calculated with $I_m = k\frac{m}{F_n}\ [t/MN]$, where the correcting factor k calculated with $k = k_1 \cdot k_2 \cdot k_3$, demonstrate mostly the principals of the dimension modification (courses, free gateway, plate dimensions and total augment) of the studying equipment.

5. REFERENCES

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