PLOUGH MINING

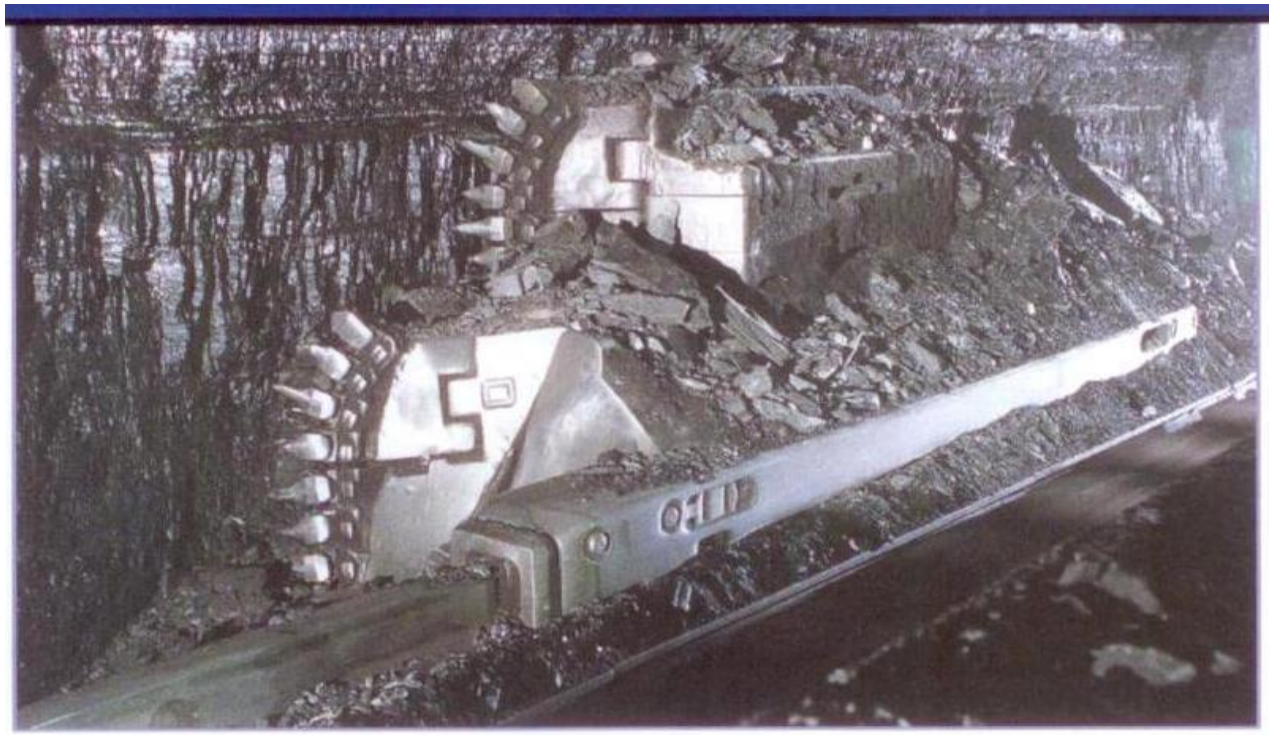
About Plough Mining

- Automated **plow** systems are making a significant contribution to the **coal** production throughout the world, in countries including China, Russia, Czech Republic, Germany, Kazakhstan, Mexico, Poland, Ukraine, and the United States.
- **plow** systems have shattered world production records for thin-seam longwall production and productivity.

Applicabilities

- As a result of their unique features and high performance, automated **plow** systems are the preferred **mining** method for seams below 1.8 meters.
- Selective mining can be done.
- Can be worked out at greater depths
- Negotiates steeper inclinations.

Plough at work



11th Plough to CHINA

Seam Height: 1.0 m to 1.2 m

Face Length: 240 m; Likely to start from March,2013.

Cat's 11th longwall plow heads to China

Caterpillar has signed a contract to deliver an automated longwall plow system to Chinese miner, Gasification Co of Lvliang Dongyi Group.

The plow system is the 11th from DBT/Bucyrus/Caterpillar to be delivered to China. It will arrive at the Xinyan mine in Shanxi province in the March quarter of 2013.

Tiefa Coal Mining Group already owns four such systems, which it uses to mine thin seam coal reserves.

The new system will mine metallurgical coal seams from 1.0-1.2m in height. The face will be

The longwall plow will arrive at the Xinyan mine in Shanxi province

240m in length. The GH800 plow will be paired with a Caterpillar armoured face conveyor using PF3 line pans, and a PMC-R roof support control system will manage roof support advance.

Plow Face at Island Creek VP 1 Mine (around 1980)

Advantages of Plough Mining

- Opportunity for Increased Production In Thin Seams
- Opportunity for Improved Reserve Recovery
- Opportunity for Reduced Roof Control Costs
- Reduce Preparation Costs
- Selective mining can be done
- Can negotiate faults to some extent.
- More safety.
- Economy.

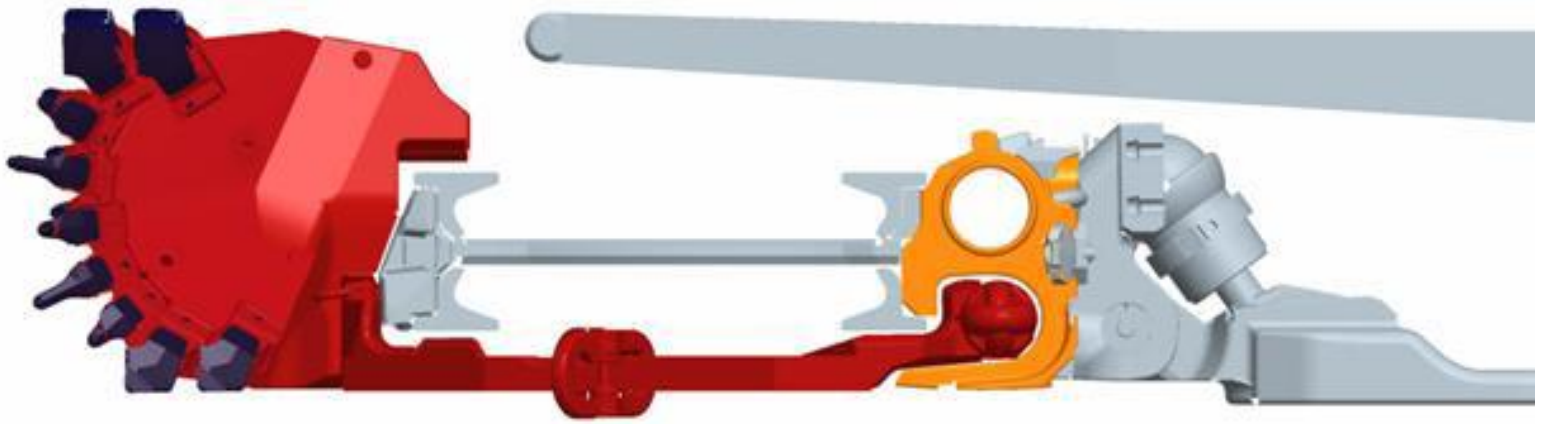
Automated Plow System in the USA US Steel's Pinnacle Mine (1989/1990)

Surface compatibility test in 1989 (world's first automated longwall face without the need for an operator at the face)

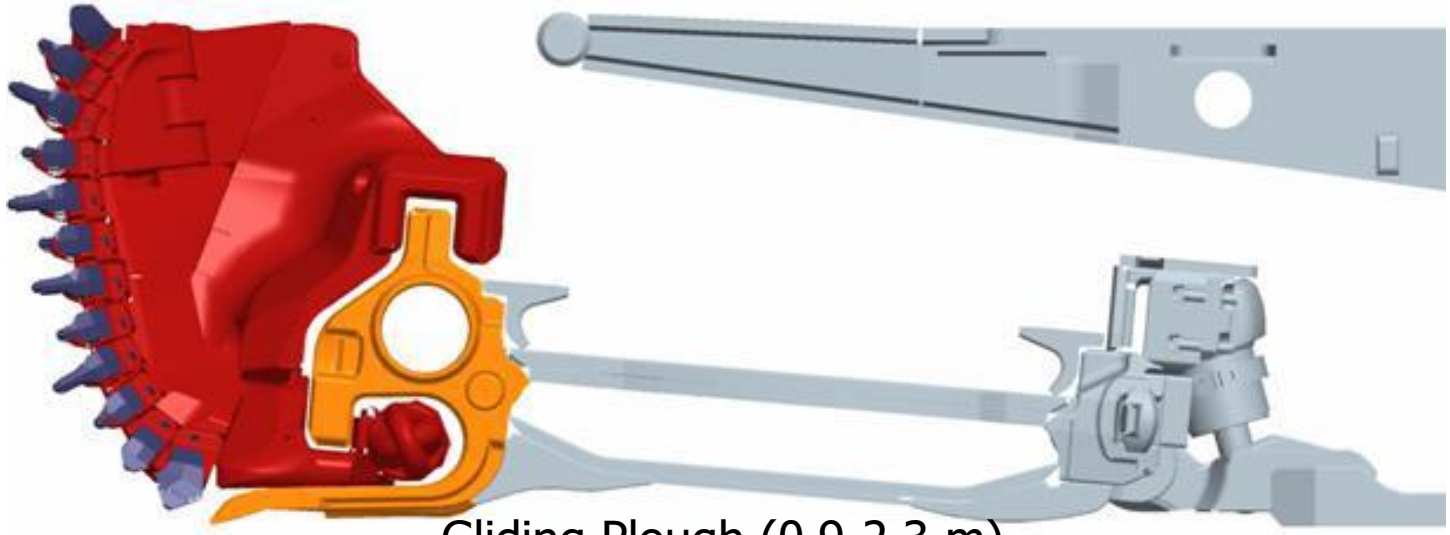
Automated Plow System in the USA US Steel's Pinnacle Mine (1989/1990)

Surface mini-build for a new plow face in 2000, legacy shields now with PM 4

Plow Types



Base Plate Plough (600 mm-800 mm)



Gliding Plough (0.9-2.3 m)

Recent Improvements in Ploughs

- **Installed power:**

- Available power on plow systems has steadily increased. Today's plow systems have up to 2,160 hp (1.6 MW) of total installed cutting power.

- **Web setting:**

- Reliable microprocessors and sensors resulted in a breakthrough for plows. Today, incremental plowing allows a setting of cutting depth with high precision, thus eliminating previously frequent blockages or 'shadow-plowing'.

- **Overload protection:**

- Chain breakages have been greatly reduced through implementation of effective overload protection systems and of the plow body shock absorber.

PLOUGH MINING

BHPL AREA

Salient features of Plough mining in BHPL area

- BHPL area has got very good virgin patches which are amenable only for plough mining.
- A total of about 69.33 MT
- Premium grade coal “A” grade reserves of about 20 Mt (in IV and IVA seams) in existing mines which are proved.
- The present ‘B’ grade producing III seam (> 3m thick) in BHPL was split into IIIA and III B (thin) seams beyond 300 m depth which can only be worked out by Plough mining.

Thin seam reserves of BHPL area

Sno	Mine	Working Seams with technology	Tot Extractable Reserves(FR) in MT	Seam	Thickness	Parting	Gradient	Additional Reserves (Mt)	Grade
1	KTK (I,IA,2,2A,		12.916 & 7.26	1A	0.7-2.90 m	**IA&I- 28-49 m**	1in 2.5to3.0m	9	D
	3,3A)			IV	**0.92-2.0 m**	**IVA & IV-25-24 m**		9.32	B
2	KTK 5	3 Seam - H/s and SDL (Dev and Dep)	18.54	1A	0.8-3.4 m	**IA&I- 30.5-34.8m**	1in 2.5to3.0m	**1.67**	D
				IV	0.11-1.8 m	**IVA & IV-19-22 m**		**0.25**	C
3	KTK 6	1,2 &3 Seams - H/s and SDL (Dev and Dep)	4.36	1A	0.7-2.9 m	IA&I-29m-49 m	1in 2.5to3.0m	**3.2**	C&D
				IV A	0.4-2.23m	III&IVA-8-13 m		**4.55**	A& B
				IV	0.92-2.0 m	IVA&IV-15-24m		**6.52**	A
4	KTK LW	IA,II,III, Development with SDL	80.00	IB	**0.9-2.10 m**	IB&IA-16-23 m	1 in 2.8 to 3.3	**7.34**	F
				III B	**NA**	II &IIIB-52-73 m		5.14	C/D
				IIIA	**NA**	IIIB&IIIA-16-21m		3.46	C/D
				IVA	**NA**	III&IVA-12.5-30m		8.54	D/E
				IV	0.6-2.15 m	IVA&IV-19-26m	1 in 2.7 to3.1	**10.34**	A
								69.33	

Challenges ahead

- More than 300 Kg/ sq.cm compressive strength of coal
- Depth > 300 m
- Steep seams
- Hard/ stone roof
- Identification of suitable business model and to achieve guaranteed production.

Opportunities

- Premium grade coals
- ‘A’ grade coal – 21.41 MT (IV and IVA seams)
- 9.32 MT- ‘B’ grade; 12.05 MT- ‘C’ grade;
- 19.21 MT-’D’ grade; 7.34 MT-’E’ grade;
- Mechanization and TPO experience in BHPL area at KTK Longwall Project.
- FSA to KTPP
- Not amenable for opencast mining in future

Conclusions

- “Change is the order of the day”
- Bulk production technological innovations are the need of the hour.
- One of such innovation in view of future

demands of the country with higher production and productivity is the “Plough technology”.

Note: Business models like TPO/MDO/Public-Private partnerships/Risk-Gain sharing basis can be envisaged to minimize the capital expenditure.